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ZOFIA KIELAN-JAWOROWSKA, DEMBERLYIN DASHZEVEG and BORIS A. TROFIMOV

EARLY CRETACEOUS MULTITUBERCULATES FROM MONGOLIA AND A COMPARISON WITH LATE JURASSIC FORMS

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A collection of multituberculates consisting of 68 specimens (teeth or their fragments and jaw fragments) from the ?Aptian or Albian Khovboor Beds in the Gobi Desert is described. It contains four species: *Eobaatar magnus* gen. n., sp. n., and *E. minor* sp. n. (assigned to the Eobaataridae nov. in Taeniolabidoidea), *Monobaatar mimicus* gen. n., sp. n., (assigned to the family *incertae sedis*) and *Arginbaatar dimitrievae* Trofimov (assigned to the Arginbaataridae in ?Plagiaulacoidea). For *E. magnus* and *A. dimitrievae* upper and lower elements are matched, *E. minor* is based on lower teeth, *M. mimicus* on upper teeth. Both the Eobaataridae and Arginbaataridae have five upper and three lower premolars. Eobaataridae has lower incisor with limited enamel band and P_4 parallel-sided with single basal cusp; it is in some respects intermediate between the Plagiaulacidae and Late Cretaceous Taeniolabidoidea. Arginbaataridae has lower incisor completely covered with enamel. It is highly specialized in the structure of P_4, which is only partly covered with enamel and rotated during ontogeny; on the other hand, it retains primitive features: upper canine and double infraorbital foramen. Both the Eobaataridae and Arginbaataridae have gigantoprismatic enamel. If gigantoprismatic enamel made its appearance only once in multituberculate evolution, one should expect that both families share a common ancestor, which would be a plagiaulacid. Some Late Jurassic and Early Cretaceous British and Late Jurassic North American multituberculates are figured for comparison. It is demonstrated that *Ctenacodon* has two infraorbital foramina. The systematic position of some *Bolodon* species is discussed.

Key words: Multituberculata, Mammalia, Cretaceous, Jurassic, Mongolia.

Zofia Kielan-Jaworowska, Paleontologisk Museum, Universitetet i Oslo, Sars Gate 1, N-0562 Oslo 5, Norway; Demberlyin Dashzeveg, Department of Paleontology and Stratigraphy, Geological Institute, Mongolian Academy of Sciences, Ulan Bator, Mongolian People's Republic; Boris A. Trofimov, Paleontological Institute USSR Academy of Sciences, Profsojuznaja 113, 117321 Moskva V-321, USSR.
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INTRODUCTION

Early Cretaceous multituberculates are poorly known. Simpson (1928), Clemens (1963*a*) and Clemens and Lees (1971) described isolated teeth from Wealden (Neocomian) beds of southern England and assigned them to the plagiaulacid *Loxaulax valdensis*. It appears from the published evidence (see Clemens and Lees 1971; Hahn 1977, and Hahn and Hahn 1983) that more than one multituberculate species is present in the Early Cretaceous beds of Great Britain. A more diverse multituberculate fauna was found in Barremian (possibly also Aptian) beds of the province of Teruel in east-central Spain. Crusafont-Pairó and Adrover (1966) described *Parendotherium herreoi* as a dryolestid pantothere, although subsequent authors (see Clemens *et al.* 1979) regard it as the upper incisor of a multituberculate. Hahn and Hahn (1983) demonstrated that *P. herreoi* is an I^2 belonging to the Paulchoffatiidae. From the same beds Crusafont-Pairó and Gibert (1976) described isolated teeth that they assigned to *Paulchoffatia*, *Bolodon* and *Kuehneodon* (in the Paulchoffatiidae) and *Plagiaulax* (Plagiaulacidae), all without identification at the specific level.

Early Cretaceous multituberculates have not been described from North America, although there are large collections of isolated teeth from the Albian of Texas, housed both in the Field Museum of Natural History in Chicago (135 specimens, Patterson 1956) and in the Shuler Museum of Paleontology, Southern Methodist University in Dallas (Slaughter 1965);

according to Dr. David W. Krause (personal information) there are about 35 multituberculate specimens in this latter collection.

Recently some 13 multituberculate jaw fragments and 26 isolated teeth or their fragments from the ?Aptian or Albian beds in Khovboor, Guchin Us somon (county), Gobi Desert, Mongolia, were collected by the Soviet-Mongolian Paleontological Expeditions (Beliajeva *et al.* 1974) and are housed in the Institute of Palaeontology USSR Academy of Sciences in Moscow. From this collection a single multituberculate genus and species *Arginbaatar dimitrievae* (assigned to the ?Taeniolabidae) has been described (Trofimov 1980). Hahn and Hahn (1983) erected the Arginbaataridae for *Arginbaatar* within the Plagiaulacoidea.

Another collection of multituberculates including 6 jaw fragments and 23 teeth from the same beds and locality was assembled by one of us (D.D.) and is housed in the Institute of Geological Sciences, Mongolian Academy of Sciences in Ulan Bator. Since the Moscow and Ulan Bator collections supplement each other, we thought it desirable to describe them jointly. Description of this fauna is the subject of the present paper.

Some of the described Early Cretaceous Mongolian forms are similar to those from the Purbeck and Wealden of Great Britain and from the Morrison Formation (Late Jurassic) of North America. Therefore we publish here, for comparative purposes the photographs and drawings of casts of some British and North American specimens.

Abbreviations used:

BM British Museum (Natural History), London;
GI Institute of Geological Sciences, Mongolian Academy of Sciences, Ulan Bator;
PIN Palaeontological Institute, USSR Academy of Sciences, Moscow;
YPM Peabody Museum, Yale University, New Haven;
ZPAL Institute of Paleobiology, Polish Academy of Sciences, Warsaw.

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Dr. David W. Krause (State University of New York, Stony Brook) and Prof. Gerhard Hahn (Phillips-Universität, Marburg) kindly read draft and final copies of our manuscript, examined part of the collections and offered most useful criticism and comments. Dr. Jeremy J. Hocker (British Museum, Natural History) and Prof. John Ostrom (Yale University, New Haven) sent casts of Late Jurassic multituberculates from Great Britain and North America respectively, and allowed us to publish the photographs of some of them.

This paper has been written in part during the Z.K.J. stay in Paris at the Institut de Paléontologie, Muséum National d'Histoire Naturelle, and completed at the Institute of Paleobiology in Warsaw in 1985—1986. Professor Philippe Taquet, Director of the Institute in Paris provided Z.K.J. with facilities for studying within the Institut and offered great hospitality and assistance; M^{me} Cristiane Weber-Chancogne from the same Institute took the majority of SEM micrographs. The following persons from the technical staff of the Institute of Paleobiology in Warsaw helped us in the preparation of this paper: Mr. Marian Dziewiński and Mr. Wojciech Skarżyński took the standard photographs and the remainder of the SEM micro-

graphs, respectively; Ms. Elżbieta Gutkowska-Leszak made the drawings after Z.K.J. pencil sketches; Mr. Wojciech Siciński and Ms. Danuta Sławik mounted the plates.
To all these persons and institutions we express our deepest thanks and gratitude.

TERMINOLOGY

We use the standard terminology of previous authors to describe multituberculate teeth (e.g., Clemens 1963*b*, Kielan-Jaworowska 1970; Krause 1977; Clemens and Kielan-Jaworowska 1979, etc.), but one structure requires terminological explanation. In the Paulchoffatiidae (Hahn 1969, 1971, 1978) and in the Plagiaulacidae (Simpson 1928, 1929) there occurs on the buccal side of P_4 a row of posterobasal cusps, which may be completely worn in specimens of old individuals. In addition to these cusps, in the Plagiaulacidae and in the Purbeckian members of the Paulchoffatiidae, such as *Plioprion* (pl. 10), there occurs a distinct, roughly horizontal shelf above the posterior root, but below the row of basal cusps in older individuals. Because this shelf appears to be developed only through occlusal wear of the enamel above it, we propose to call it the posterior wear shelf. In *Eobaatar magnus* sp. n. (pl. 1: 1*a* and 3*a*) there occurs a single cusp, situated high on the crown, just below the posterior serration. We call it the basal cusp and suggest that it might be a remnant of the row of basal cusps present in the Plagiaulacidae and in the Paulchoffatiidae. But in an older individual of *E. magnus* (pl. 1: 4*a*) the basal cusp became worn out and the posterior wear shelf developed, as in the plagiaulacid genera. A distinct basal cusp is retained in most Late Cretaceous and Tertiary taeniolabidoid and ptilodontoid genera, sometimes called basal cuspule. Archibald (1982) used the therm basal shelf to designate the row of two cusps, situated rather high on the crown of P_4 in *Acheronodon garbani*. These possibly correspond to basal cusps, rather than to the posterior wear shelf in the meaning adopted herein. There is no basal cusp and consequently no posterior wear shelf in the Arginbaataridae.

SYSTEMATIC DESCRIPTION

Introductory remarks

The majority of known Khovboor specimens are isolated teeth. There are, nevertheless, some incomplete mandibles with two, three and in one case four teeth, and fragmentary maxillae with two, three or four premolars and alveoli. The lower and upper teeth or jaws have not been found in occlusion or in association. There are possibly three or four species in the reviewed collections and the reconstruction of matching upper and lower elements poses difficulties. Nevertheless, it was possible in two cases (*Eobaatar magnus* gen. n., sp. n. and *Arginbaatar dimitrievae* Trofimov) to match isolated lower and upper jaws and teeth with some confidence on the basis of size, ornamentation and the frequency of occurrence, although we could not apply statistical methods due to the small sample. In the case of *Eobaatar* *magnus* we based our assignements also on similarities to the known members of the Plagiaulacidae, to which *Eobaatar* (although assigned to a different suborder) is closely related. In one case, because of ambiguity, we decided to erect new taxa separately for lower and upper elements. The details of our reasoning are discussed along with the systematic descriptions.

In addition to the established taxa we described some isolated teeth, identified only at the generic level, or as, e.g., "Unidentified upper incisor".

We assign the Arginbaataridae Hahn et Hahn to the ?Plagiaulacoidea, while the Eobaataridae nov. is placed in the Taeniolabidoidea. In spite of these subordinal assignments we start systematic description with the Eobaataridae, as it is less specialized than the Arginbaataridae.

Suborder **Taeniolabidoidea**
Family **Eobaataridae** nov.

Diagnosis. — Lower incisor with limited enamel band. Three lower premolars, P_4 parallel-sided, not overhanging P_3. No row of accessory basal cusps on P_4, but posterior basal cusp present. M_1 similar to M_2, both asymmetrical (shorter lingually than bucally) with two rows of cusps. Five upper premolars. M^1 with two rows of cusps and small posterolingual, crescent-shaped wing. Enamel gigantoprismatic.

Occurrence. — Early Cretaceous: Wealden of Sussex, Great Britain and ?Aptian or Albian, Guchin Us somon, Gobi Desert, Mongolia.

Genera assigned: *Loxaulax* Simpson, 1928; *Eobaatar* nov.

Discussion. — The subordinal assignment of the Eobaataridae poses difficulties as it shows a mosaic of plagiaulacoid and taeniolabidoid characters. We assign it to the Taeniolabidoidea because of the limited enamel on the lower incisor which is a taeniolabidoid synapomorphy and does not occur in any other multituberculate group. The Eobaataridae has five upper and three lower premolars as is characteristic of the Plagiaulacoidea (although in most Plagiaulacoidea there are four lower premolars). The shape of the upper premolars is rather of plagiaulacoid than taeniolabidoid pattern. P_4 is parallel-sided as in the Plagiaulacoidea, rather than arcuate and overhanged over P_3 as in the Late Cretaceous Taeniolabidoidea (see Kielan-Jaworowska 1970, 1971, 1974, Kielan-Jaworowska and Dashzeveg 1978, Clemens and Kielan-Jaworowska 1979), with a single basal cusp rather than a row of basal cusps characteristic of the Plagiaulacoidea. The enamel is gigantoprismatic as in the Taeniolabidoidea, this latter character however cannot be regarded as taeniolabidoid synapomorphy, as it occurs in the Arginbaataridae, which we tentatively assign to the Plagiaulacoidea and in the Cimolomyidae the subordinal allocation of which is uncertain (Fosse *et al.* 1985, Carlson and Krause 1985).

We assign to the Eobaataridae two genera: *Eobaatar* gen. n. and poorly known *Loxaulax* Simpson, 1928, from the Wealden of Great Britain. The P_4 of *Loxaulax* is not known and it cannot be demonstrated unequivocally that *Loxaulax* is an eobaatarid, rather than a plagiaulacid. Neverthless some similarities in structure of M_1 and M^2 of *L. valdensis* (the only named species of *Loxaulax*) and *E. magnus*, discussed on p. 15, suggest that *Loxaulax* warrants inclusion in the new family.

Genus *Eobaatar* nov.

Etymology: Gr. *eos* — dawn, Mong. baatar — hero.

Type species: *Eobaatar magnus* sp. n.

Diagnosis. — P_2 peg-like and single-rooted; P_3 double-rooted; measuring less than half the length of P_4. P_4 with 9—10 serrations. In lower molars cusps in the lingual row crescent-shaped, facing towards the middle, cusps of the buccal row facing posteriorly. Cusps in lower molars show a tendency to coalesce with each other. In upper teeth (tentatively assigned) P^1 — P^3 three to four-cusped; P^4 and P^5 similar to each other, with main row of cusps forming cutting edge; M^1 with minute postero-lingual wing; M^2 relatively wide, with nearly straight anterior margin. Premolar and molar cusps ornamented.

Species assigned: *Eobaatar magnus* sp. n., *Eobaatar minor* sp. n., *Eobaatar* sp. *a*, *Eobaatar* sp. *b*.

Occurrence. — Khovboor beds (?Aptian or Albian), Khovboor, Guchin US somon, Gobi Desert, Mongolia.

Eobaatar magnus sp. n.

(pls. 1: 1—4; 2; 3: 1—2; 4; 5; 6: 3, 4; 7: 4; 16: 1; figs. 1A—D; 2A—C; 3B)

Holotype: Left P_4, PIN 3101/57.

Type horizon and locality: Khovboor Beds (?Aptian or Albian), Khovboor, Guchin Us somon, Gobi Desert, Mongolia.

Diagnosis. — Estimated length of the skull about 3 cm. P_4 with 9—10 serrations with ridges; V-shaped groove above the basal cusp. Ventral margin of exodaenodont lobe V-shaped. P_4 3.1—3.6 mm long. Cusps 4:2 on M_1 and 3:2 on M_2. The second buccal cusp on M_1 larger than others, the first lingual cusp subdivided medially. Ultimate buccal cusp on M_2 subdivided medially by comma-shaped grooves. P^1—P^3 with 3—4 cusps. ?P^4 with 3:4 cusps; ?P^5 with 2:4 cusps; M^1 with 3:4 cusps and crescentic wing; M^2 with 1:3:3 cusps and straight anterior margin; anterior rim enlarged in the middle and reaching the first medial cusp. Lower molars ornamented with comma-shaped grooves; upper premolars and M^1 ornamented with prominent striae, on M^2 only anterolateral wing and lateral side of middle medial cusp ornamented with grooves and striae.

Reconstruction. — We assign to *E. magnus* in addition to the holotype (based on P_4), the mandibles with lower molars and upper premolars and molars, because they all correspond to each other in size and display an ornamentation of prominent striations on upper premolars and M^1, striations and grooves on M^2 and grooves only on lower molars. Within each category of teeth only one type of this size with ornamentation occurs in the Khovboor assemblage. Upper teeth, when arranged in anatomical order, resemble those of Purbeckian *Bolodon osborni*, while the lower ones resemble those of *Plagiaulax becklesii*.

Material. — In addition to the holotype specimen we assign here: PIN 3101/53 fragment of left mandible with M_1, M_2 and posterior alveolus for P_4; PIN 3101/60 right P_4; PIN 3101/59a anterior part of left P_4; PIN 3101/59b posterior part of left P_4 strongly worn; GI PST 10—43 fragment of right mandible with M_2; PIN 3101/50e left M_1; GI PST 10—34 right P^x (?P^1 or P^2); GI PST 10—35 left P^x (?P^3); GI PST 10—27 right ?P^4; GI PST 10—16 right ?P^5; GI PST 10—45 left ?P^5; GI PST 10—31 left ?P^5; GI PST 10—24 left ?P^5; GI PST 10—33 left M^1; PIN 3101/66 right M^1; PIN 3101/62 right M^2.

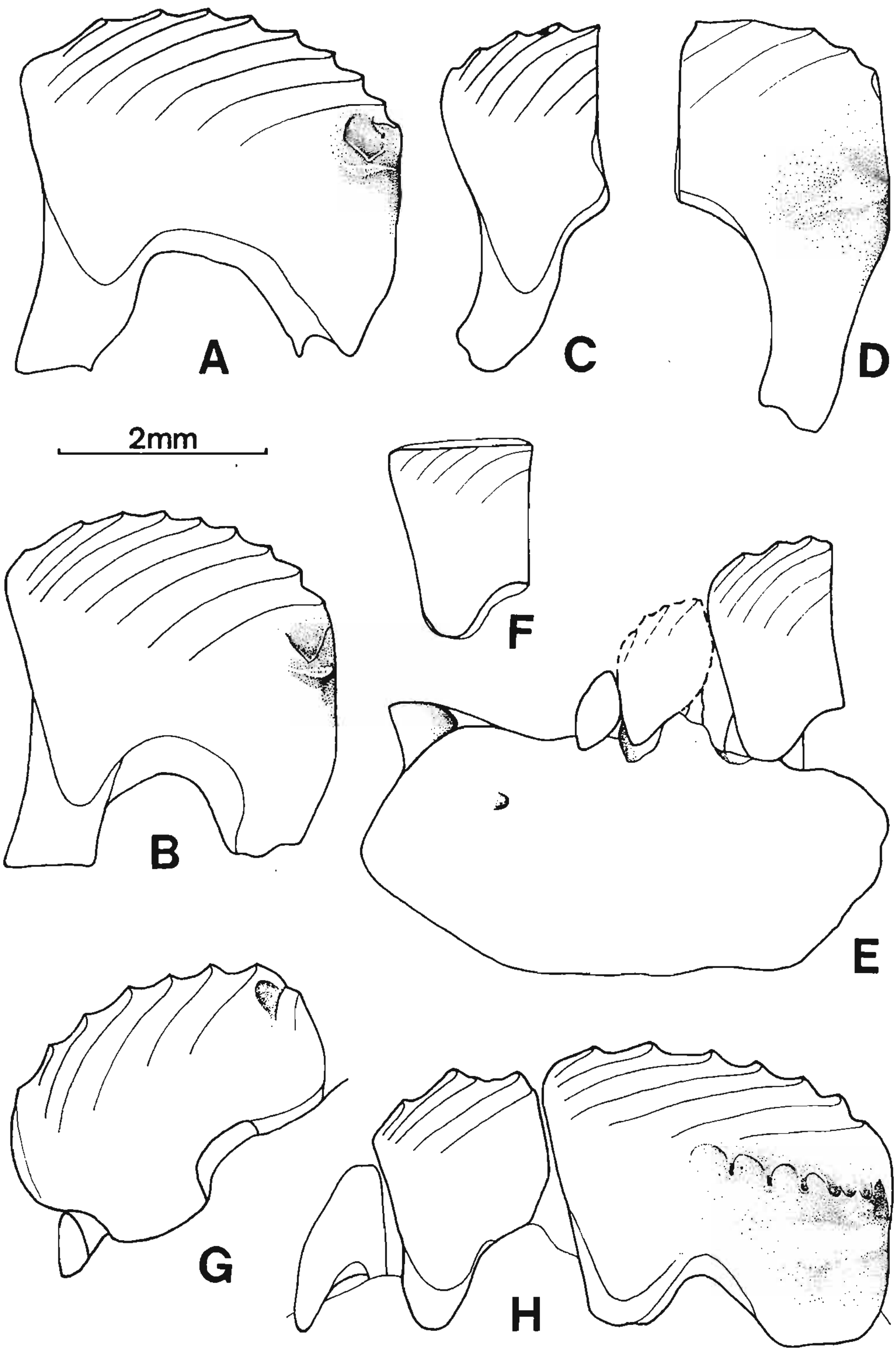
Description. — *Mandible.* The fragments of mandible have been preserved in PIN 3101/53 and GI PST 10—43 (pl. 2: 1—2). The mandible is robust, more than 3.5 mm deep below M_1 (broken). The strong coronoid process strats opposite the ultimate cusp of M_1.

Lower teeth. The four P_4's assigned to *E. magnus* (pls. 1: 1—4 and 16: 1) differ in proportions. The holotype is 3.6 mm long and 2.1 mm high (between the roots), while PIN 3101/60 is 3.1 mm long and 2.2 mm high. The fragmentary P_4 PIN 3101/59a is still somewhat shorter than PIN 3101/57, being probably only 1.8 mm or 1.9 mm high between the roots. PIN 3101/59b is strongly worn, and its measurements cannot be given. In PIN 3101/57 there were 10 serrations, but the first one has been worn (pl. 16: 1) and 9 are preserved. In PIN 3101/60 there are 9 serrations and all except the first one bear ridges. In all specimens except the worn PIN 3101/59b the ridges are very prominent near the serrations and less distinct ventrally. The distance between the first three ridges are smaller than between the successive ones. In PIN 3101/59a the first serration, which is worn in PIN 3101/57 and PIN 3101/60, is preserved. In this specimen the anterior ridges are bent somewhat more strongly downwards than in the others. In PIN 3101/57 and PIN 3101/60 the basal cusp is prominent and above it there is a distinct V-shaped groove. The ventral margin of the exodaenodont lobe is V-shaped.

PIN 3101/59b on first sight differs dramatically from other specimens of *E. magnus*, but we regard these differences as due to the strong wear of this specimen. It has a strongly worn upper margin, but when unworn it might be of the size of PIN 3101/57. If differs from other specimens of *E. magnus* in the lack of basal cusp and V-shaped groove above it, and in having a posterior wear shelf (at the level of the interradicular margin). We believe that the basal cusp in this specimen (and the groove above it) have been worn away, and that the posterior wear shelf has been developed as a result of the wear of the enamel on the buccal side. Because of the wear, the last two serrations that are preserved in this specimen are less prominent that in unworn ones. The same concerns the ridges, which in comparison with unworn specimens of *E. magnus* are very weak. The distances between the ridges seem insignificantly wider than in unworn specimens, but this is an illusion caused by the wear of the ridges in the discussed specimens. Taking all this into account we think that PIN 3101/59b belonged to an old individual of *E. magnus.*

M_1 (pl. 2: 2, 3) is asymmetrical with an oblique posterior margin. PIN 3101/53 is 1.8 mm long buccally, 1.4 mm lingually and is 1.1 mm wide; in PIN 3101/50c these measurements are respectively 1.6 mm, 1,3 mm and 1.1 mm. Cusp formula is 4: 2. Cusps in the lingual row are crescentic and face towards the middle of the tooth. We recognize only two cusps in the lingual row, but the first one is very large and is subdivided medially by a transverse furrow. As this subdivision is not complete and is hardly seen in lingual view (especially in PIN 3101/53 see pl. 2: 2), we prefer to recognize two rather than three lingual cusps. Lingual cusps are taller than buccal cusps. Of the four cusps in the buccal row the two first are subcrescentic and face posteriorly. The second one is the largest of all. The two posterior cusps in the buccal row are somewhat differently shaped in two specimens. In PIN 3101/53 the penultimate cusp is larger than the ultimate and on the ultimate there is an ornamentation of comma-shaped grooves or pits. In PIN 3101/50e the penultimate cusp is somewhat smaller than the ultimate and the ornamentation on the ultimate cusp consists primarliy of one long groove, which subdivides this cusp into two (the first one tubercle-like) parts.

M_2 (pl. 2: 1, 2) is generally similar to M_1; in PIN 3101/53 it is 1.8 mm long buccally, 1.3 mm long lingually and 1.4 mm wide; in GI PST 10—43 these measurements are respectively 1.6 mm, 1.3 mm and 1.5 mm. The posterior margin is strongly oblique with regard to the longitudinal axis. Cusp formula is 3:2. Cusps in the lingual row are taller than those in the buccal row. The cusps in the lingual row are crescentic and face medially. The first one (as in M_1) is subdivided medially by a short transverse groove, the subdivision not being seen in lingual view. The three cusps in the buccal row are recognized only medially, as in the buccal view they are completey coalesced with each other. The recognition of these cusps may be a matter of argument, as the three cusps (two anterior ones very short, and large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ultimate one) are separated by transverse grooves, not unlike the comma-shaped grooves on the ultimate cusp. The two specimens differ in ornamentation of the ultimate buccal cusp. In PIN 3101/53 it consists of short grooves or pits irregularly arranged, while in GI PST 10—43 the ornamentation consists of two transverse grooves which subdivide the penultimate cusps into two anterior transverse strips and a larger posterior area, covered with irregular grooves and pits. In PIN 3101/53 the ornamentation occurs also on the first cusp of the buccal row in the form of two pits.

Upper teeth. Right P^x (?P^1 or P^2) GI PST 10—34 (pl. 3: 1) is subtriangular in occlusal view, 1.1 mm long and 1.1 mm wide, with three large cusps and one minute cuspule. Of the three large cusps the largest is possibly the buccal. The two lingual cusps are subequal in size. The minute cuspule is placed in front of the buccal cusp. On the posterior part of the tooth, behind the cusps there is a smooth crescentic cingulum. The two roots are very long, robust, somewhat convex outwards. We identify this tooth as the right one on the basis of similar arrangement of the cuspule and of the posterior cingulum, as in right anterior premolars of different *Bolodon* species (see pl. 12).

Left P^x (?P^3) GI PST 10—35 (pl. 3: 2), this tooth differs from GI PST 10—34 in being somewhat larger (it is 1.2 mm long and 1.2 mm wide), in being more quadrangular than triangular in occlusal view and in having four cusps. The smallest cusp possibly corresponds to the cuspule in GI PST 10—34. The posterior crescentic cingulum which is conspicuous in GI PST 10—34, in GI PST 10—35 is hardly developed. All cusps are ornamented with radiating striae. The tips of all the cusps are worn, the buccal ones more strongly than the lingual.

Right ?P^4 GI PST 10—27 (pl. 4: 1). The cusp formula is 3:4. The tooth is 1.6 mm long and 1.3 mm wide anteriorly. It narrows posteriorly. It has a rounded anterolateral wing opposite the anterior part of the buccal row. The first two buccal cusps are subequal, the third one the smallest. The lingual cusps increase in size posteriorly. From the last one a short ridge extends posteriorly to the pointed end of the tooth. The lingual wall of the tooth prolongs above the cusps to form a smooth shearing surface, which is relatively short anteriorly and becomes deeper opposite the last two cusps. All cusps are ornamented with conspicous, radiating striae. In addition there is an ornamentation os small cuspules, also covered with striae. One of them is positioned lateral to the first cusp of the buccal row, on the anterolateral wing, the other — anteromedial to the same cusps, near the anterior margin of the tooth. The roots are very strong and diverge upwards.

?P^5 (pls. 4: 2, 3; 5) — four specimens, left ones: GI PST 10—31, GI PST 10—24, GI PST 10—46; right one: GI PST 10—24. Cusp formula is 2:4, in front of the anterior cusp of the buccal row there is in some specimens a small cuspule. GI PST 10—31, 10—24 and 10—45 are each 1.7 mm long and 1.2 mm wide anteriorly. They differ in

Fig. 1. Comparison of P_4's in buccal view, of *Eobaatar* (from Early Cretaceous Khovboor Beds), *Kryptobaatar* (from Late Cretaceous Djadokhta Formation) and *Plagiaulax* (from Late Jurassic — Middle Purbeck), *A—D Eobaatar magnus* sp. n.; *A*, left P_4, PIN 3101/57 holotype; *B*, right P_4 reversed, PIN 3101/60; *C*, anterior part of left P_4, PIN 3101/59a; *D*, posterior part of strongly worn left P_4 showing the posterior wear shelf, basal cusp in this specimen is completely worn out, PIN 3101/59b; *E*, *Eobaatar minor* sp. n., fragment of right mandible, reversed, with anterior part of P_4 and P_2 and alveolus for incisor, P_3 reconstructed, PIN 3101/70 holotype; *F*, ?*Eobaatar minor* sp. n., anterior part of left P_4, GI PST 10—23; *G*, *Kryptobaatar dashzevegi* Kielan-Jaworowska, right P_4 reversed, ZPAL MgM-I/22 holotype; *H*, *Plagiaulax becklesii* Falconer, right P_2—P_4 reversed, apical part of P_3 damaged, BM 47731 holotype.

width across the ultimate cusp of the lingual row, which is 1 mm in GI PST 10—31 and 10—24, but 0.9 mm in GI PST 10—45. GI PST 10—16 has been broken after being photographed and cannot be measured. The cusps in the lingual row distinctly increase in size posteriorly, those of the outer row are subequal, or the first one is insignificantly smaller than the second. Lateral to the two cusps of the buccal row there is a small wing. The lingual side above the cusps forms a smooth shearing surface, relatively low anteriorly and increasing in size posteriorly. All cusps are ornamented with radiating striae.

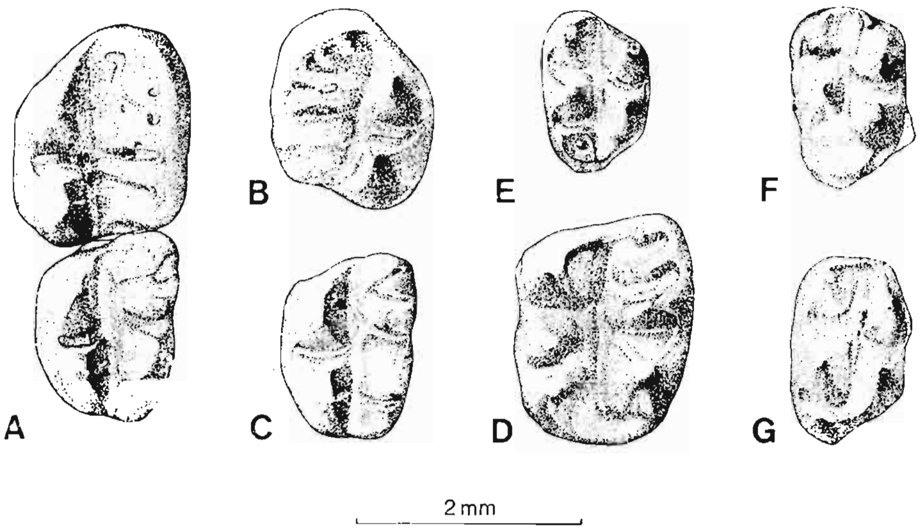


Fig. 2. Comparison of lower molars in occlusal view, of *Eobaatar* and *Arginbaatar* (both from Early Cretaceous Khovboor Beds in Asia) and *Loxaulax* (from Early Cretaceous. Wealden of Great Britain). *A*—*C*, *Eobaatar magnus* sp. n., *A*, left M_1 and M_2 PIN 3101/53, *B*, right M_2 GI PST 10—43; *C*, left M_1 PIN 3101/50e; *D*, *Loxaulax valdensis* (Smith Woodward), left M_1, BM 10480; *E*—*G* *Arginbaatar dimitrievae* Trofimov, *E*, right M_1, PIN 3101/50c; *F*, right M_1, PIN 3101/49 holotype; *G*, right M_1 GI PST 10—42.

There are some differences in proportions between the measured teeth. All of them are narrower posteriorly than anteriorly, but in GI PST 10—31 and 10—24 the difference in width is not great, while in GI PST 10—45 and 10—16 it is more conspicuous. The differences in proportions appear not sufficiently great to regard these teeth as belonging to different taxa.

M^1 two specimens (pl. 6: 3, 4): GI PST 10—33 left M^1, 1.9 mm long and 1.3 mm wide anteriorly, and PIN 3101/66 right M^1, 1.7 mm long and 1 mm wide anteriorly, with partly broken anterior margin. Cusp formula 3:4:1. Lingual cusp is developed as crescentic wing, positioned opposite the ultimate cusp on the medial row. The wing is smaller in PIN 3101/66 than in GI PST 10—33, which might be due to wear, although PIN 3101/66 is less worn than GI PST 10—33. The anterior margin is arranged slightly obliquely with regard to the long axis of the tooth. The cusps of the buccal row are positioned opposite the embrasures between the cusps of the medial row. A ridge joins the first cusp of the buccal row with the anterior margin. From the posterior cusp of the buccal row there extends a ridge toward the posterior cusp of the medial row. The first cusp of the buccal row is in GI PST 10—33 partly subdivided: a furrow separates it from a small posterolingual cuspule. In GI PST 10—33 cusps of the buccal row are slightly worn horizontally, while cusps of the medial row are strongly worn horizontally with an inclination towards the middle groove; the worn surface of the ultimate cusp of the medial row prolongs towards the middle groove. This subhorizontal wear is only slightly manifested in PIN 3101/66. The cusps of the medial row are in both specimens strongly worn subvertically, both on lingual and medial sides, so that the ornamentation has almost completely disappeared from the cusps of the medial row. The ornamentation of conspicuous radiating striae is preserved on the cusps of the buccal row. PIN 3101/66 differs from GI PST 10—33 in being smaller, in having smaller wing and more rounded corners of the tooth. All other details are identical and we regard these teeth as conspecific.

Right M^2 PIN 3101/63 (pl. 7: 4). The tooth is roughly trapezoidal in occlusal view, with straight anterior margin. Cusp formula is 1:3:3. The tooth is 1.5 mm wide and 1.7 mm long. Along the straight anterior margin there extends a narrow rim that widens in the middle and passes onto the first cusp of the medial row, reaching its tip. This rim continues laterally and surrounds the elongated, large, conspicuously ornamented antero-lateral wing (buccal cusp). Cusps of the lingual row are subequal in size, and face (are worn) towards the groove between the lingual and medial rows. Cusps of the medial row increase in size posteriorly. The first one, the smallest, partly confluent with the anterior rim is slightly worn horizontally. The second is more worn horizontally. The third and largest is not worn horizontally. In addition the cusps of the medial row are worn towards the groove between the medial and lingual rows. The ornamentation consists of ridges with deep grooves between them. It occurs only on the anterolateral wing, and on the anterolateral and posterolateral bases of the second cusp of the medial row.

Discussion. — See p. 14.

Eobaatar minor sp. n.
(pl. 1: 5; 8: 3; fig. 1E, F)

Holotype: Incomplete right mandible with alveolus for incisor, P_2, the roots and crown fragment of P_3 and anterior part of P_4, PIN 3101/70.

Type horizon and locality: Khovboor Beds (?Aptian or Albian), Khovboor, Guchin Us somon, Gobi Desert, Mongolia.

Etymology: Lat. *minor* — small.

Diagnosis. — Estimated length of the skull is about 2 cm. Short diastema between I and P_2. P_4 small, distinctly smaller and apparently shorter anteroposteriorly than in *E. magnus*. The ventral margin of the exodaenoodont lobe rounded. The ridges on P_4 weaker and more closely arranged than in *E. magnus*.

Material. — In addition to the holotype we assign to *E. minor* tentatively an anterior part of left P_4 GI PST 10—23, from the same horizon and locality.

Description. — Height of the mandible below the diastema is in buccal view 2.1 mm and below the anterior root of P_4 1.9 mm. Height of P_4 between the roots is 1.6 mm in the holotype specimen, and 1.5 mm in GI PST 10—23, but this specimen is worn horizontally. The mandible was probably relatively short and wide.

Buccal view of the mandible: a distinct, rounded mental foramen with a short groove extending from it anteriorly, is placed 0.5 mm below the upper margin of the mandible and 0.6 mm in front of P_1. Anteroventral to the mental foramen the mandible surface is covered by a relatively large nutrient foramina. Below the anterior root of P_4 the mandible is inflated. Lingual view: in the anterior part of the mandible there is a vertical ridge evidently surrounding the symphyseal area.

Teeth: P_2 is peg-like, but pointed; it is 0.9 mm high. Posterior root of P_3 is situated somewhat more lingually than the anterior one. The crown of P_3 as preserved shows rounded ventral margin of the exodaenodont lobe. P_4 is relatively small. In PIN 3101/70 four serrations and six buccal ridges (two incomplete posteriorly) are preserved. In this specimen the ridges are very weak and the serrations are low, which may be due to the state of preservation, but there are no distinct traces of wear. The ventral margin of the exodaenodont lobe is rounded — it touches the mandible. In GI PST 10—23 the upper margin of the tooth is strongly worn horizontally, which indicates that this P_4 when unworn was possibly higher than in the holotype specimen. It differs also from the holotype in having the more prominent ridges. The rounded shape of the ventral margin of the exodaenodont lobe and small size of the tooth indicate that it might be conspecific with PIN 3101/70. The enamel of GI PSI 10—23 has been studied by Fosse *et al.* (1985) and shows the giganto-prismatic structure.

Discussion. — See below.

Unidentified teeth of *Eobaatar*

In addition to *Eobaatar magnus* sp. n. and *Eobaatar minor* sp. n. there are in the reviewed collections from the Khovboor beds two isolated incisors which apparently belong to *Eobaatar*, but the specific identification of which poses difficulties. We describe them below as *Eobaatar* sp. *a* and *Eobaatar* sp. *b*.

Eobaatar sp. *a* (Lower incisor)

(pl. 8: 5)

Description. — GI PST 10—25 is a fragmentary right lower incisor, which is gently curved and is of almost the same width of about 0.8 mm all along the preserved length. The posterior part of the preserved fragment is covered with dentine; the enamel is preserved only in the anterior (broken) part of the tooth and covers its ventral, and gradually towards the anterior, also part of the lateral (buccal) side. The enamel boundary is sharp and distinct. There is a longitudinal, wide groove along the buccal side. The enamel extends also as a very narrow strip along the ventral margin on the lingual side. Along its boundary on the dentine there is a narrow groove. The lingual side is less convex than the ventral. The tooth is compressed laterally and is oval in cross-section.

Eobaatar sp. *b* (Lower incisor)

(pl. 8: 4)

Description. — PIN 3101/67 is a fragmentary right lower incisor with limited enamel band. It differes from GI PST 10—25 in lack of longitudinal grooves on both lingual and buccal sides and in being more robust. The width of the preserved part is about 1 mm, rather than 0.8 mm in GI PST 10—25. As in GI PST 10—25 the enamel forms a narrow strip along the ventral part of the lingual side. It is compressed laterally, the buccal side is gently convex, the lingual flat, and the cross-section is oval.

Discussion

Eobaatar magnus sp. n. and *Eobaatar minor* sp. n. have been established on the basis of P_4 and mandibles. We assign to *E. magnus* in addition to P_4 also the mandibles with lower molar, and almost all upper premolars and molars. *E. minor* is less completely known and it was impossible to match the isolated upper teeth from the reviewed collection with the lower ones of *E. minor* with any certainty (but see Discussion on p. 20).

The lower incisors described above as *Eobaatar* sp. *a* and *Eobaatar* sp. *b*, have each a sharply limited enamel band, as is characteristic of the Taeniolabidoidea (Sloan and Van Valen 1965). As the lower incisor in the Arginbaataridae is completely covered with enamel, and as the only other multituberculate family in Khovboor Beds is the Eobaataridae, represented by a single genus *Eobaatar* (unless *Monobaatar* gen. n. is also an eobaatarid) we assign these lower incisors to *Eobaatar*. The two incisors differ from each other and possibly belong to two species, however, the differences in their size are so small, that it would be risky to suggest that the more robust belongs to *E. magnus* and the other one to *E. minor*.

The oldest so far known lower incisor with limited enamel band has been described from the Cenomanian of Texas, east to the Western Interior Seaway (Krause and Baird 1979). The lower incisors here described are from the ?Aptian or Albian and are older than Texas specimen.

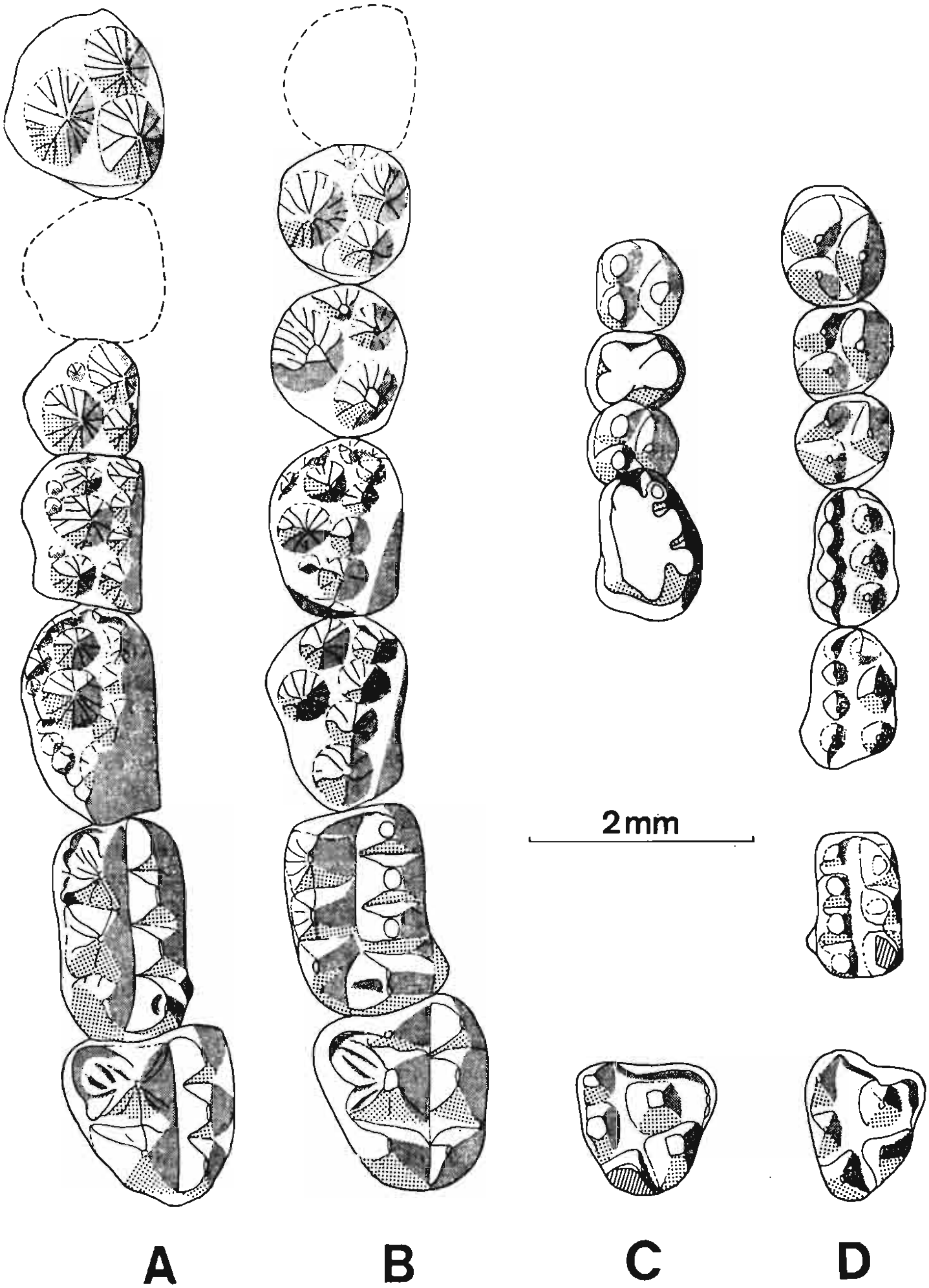
E. magnus (if correctly reconstructed) differs from *Loxaulax valdensis* Simpson, from the Wealden of Great Britain (pl. 8: 2 and fig. 2D, see also Simpson 1928, Clemens 1963*a* and Clemens and Lees 1971) in having two lingual cusps in M_1, the first one of which is subdivided, facing towards the medial groove (while there are three distinct cusps in *L. valdensis* of which the last one faces medially), and in having four (three in *L. valdensis*) lingual cusps. The M^2 in *E. magnus* has 3:3:1 cusps, while there are 4:2:1 cusps in *L. valdensis*. The anterior margin of M^2 is in *E. magnus* straight, while it is strongly sigmoid in *L. valdensis*. In spite of these differences there are strong similarities in general shape and the arrangemant of cusps in M_1 and M^2 of *E. magnus* and *L. valdensis*. In both species the posterior margin of M_1 is oblique with regard to the long axis of the tooth. Also the ornamentation on M^2 in both species is limited to the anterolateral wing (cusp) and the lateral part of the main medial cusp (second in *E. magnus* and first in *L. valdensis*). This ornamentation consists in *E. magnus* of ridges with very deep grooves between them, while in *L. valdensis* it consists mostly of comma-shaped grooves and pits. This latter type of ornamentation occurs on the lower molars of *E. magnus*.

L. valdensis is known from a single M_1 and two M^2's. It should be underlined that, as pointed out by Hahn and Hahn (1983), the two M^2's differ strikingly in proportions and only one of them may be conspecifis with M_1 of *L. valdensis*.

Comparison of *Eobaatar magnus* with Latest Jurassic multituberculates requires comments on the Plagiaulacidae.

The Plagiaulacidae Gill, 1872 embraces according to Hahn and Hahn (1983) four genera: *Ctenacodon* Marsh, 1879; *Loxaulax* Simpson, 1928; *Plagiaulax* Falconer, 1857 and *Psalodon* Simpson, 1926. Here we transfer *Loxaulax* to the Eobaataridae. *Ctenacodon* and *Psalodon* occur in the Upper Jurassic Morrison Formation of North America. We argue on p. 00 that *Ctenacodon* should be rather assigned to the Paulchoffatiidae. *Psalodon* is relatively poorly known and not seeing the original material it is difficult for us to venture an opinion whether it should be assigned to the Plagiaulacidae or Paulchoffatiidae. *Plagiaulax* occurs in the Middle Purbeck, Durlston Bay locality near Purbeck, Swanage in England. *Plagiaulax* is known from several mandibles with premolars and one tentatively assigned mandibular fragment with two molars.

In the Purbeck Durleston Bay locality, in addition to *Plagiaulax*, there occur two other multituberculate genera. *Plioprion* Cope, 1884, is represented by three species: *P. ?dawsoni* Smith-Woodward, 1891. *P. falconeri* Owen, 1891 and *P. minor* Falconer 1857 — all known from mandibles or lower teeth. *Bolodon* Owen, 1871, is represented by: *B. crassidens* Owen, 1871, known from a premaxilla with I^3 and a maxilla with


2mm
A
B
C
D

P^1—P^4; *B. ?elongatus Simpson*, 1928, known from maxillae with right P^1—P^3 and left P^1—P^2; and *B. osborni* Simpson, 1928, known from a maxilla with P^1, alveolus for P^2 and P^3—M^2. *Plioprion dawsoni* is known from a single molar, which according to Clemens (1963*a*) may not even belong to a mammal.

The three species of *Bolodon* differ considerably from one another (pl. 12). Hahn and Hahn (1983) suggested that *B. elongatus*, with strongly elongated anterior premolars, may belong to a separate new genus. On the other hand, *B. crassidens* differs in the structure of P^4 from *B. osborni* and may not be congeneric with it.

Among the lower tooth taxa from Durleston Bay there are three species: *Plagiaulax becklesii*, *Plioprion? falconeri* and *Plioprion minor*. The first two have identical P_2—P_4 (see pl. 10: 1, 2) but differ considerably in the structure of their lower incisors. In *Plagiaulax becklesii* the lower incisor is provided with a longitudinal groove; it is also very wide at the base and strongly narrows anteriorly. In *Plioprion? falconeri* the lower incisor has no groove, is relatively narrow all along its length and is reminiscent of those of the Ptilodontoidea. There is an alveolus for P_1 in *Plioprion? falconeri*, while there are only three lower premolars in *Plagiaulax becklesii*.

Of the species of *Bolodon*, *B. elongatus* is the largest, while *B. osborni* and *B. crassidens* are of approximately the same size. Among the lower tooth taxa, *Plioprion minor* is much smaller than the two others, while the mandible in *Plagiaulax becklesii* is more robust than in *Plioprion? falconeri*, although the P_2—P_4 are of approximately the same size (pl. 10, and Simpson, 1928, pl. 3 and Text-fig. 9) All *Bolodon* species display a similar type of striations, characteristic also of *Eobaatar magnus*. *Plagiaulax becklesii* is the most common multituberculate in the Durleston Bay locality and it would be surprising, if it did not have a counterpart among the upper tooth taxa from the same locality. Therefore it cannot be excluded that one of the *Bolodon* species (possibly *B. osborni*) is a counterpart of *Plagiaulax becklesii*, and if so, this species should be assigned to the Plagiaulacidae, rather than to the Kuehneodontinae in Paulchoffatiidae as suggested by Hahn and Hahn (1983). The single infraorbital foramen characteristic of *B. osborni* (Hahn 1985) is also a plagiaulacid feature; however, the number of infraorbital foramina possibly does not have an important taxonomic value, as e.g. *Ctenacodon*, is a plagiaulacid (see Concluding Remarks), but possesses two infraorbital foramina.

The P_4 of *Eobaatar magnus* sp. n. is most similar to those of *Plagiaulax becklesii* and *Plioprion? falconeri* in having parallel margins and prominent ridges. It differs in having a single basal cusp, rather than a row of cusps (which separates the Eobaataridae from the Plagiaulacidae and Paulchoffatiidae). *Eobaatar* is more similar to *Plagiaulax* than to *Plioprion* in having only three lower premolars. The lower molars of *?Plagiaulax becklesii* are known from a single strongly worn

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Fig. 3. Comparison of upper premolars and molars of *Bolodon* (from the Late Jurassic — Middle Purbeck of Great Britain) and *Eobaatar*, *Monobaatar*, *Arginbaatar* (all from Early Cretaceous Khovboor Beds of Asia); all in occlusal view in the same scale; *A—B* right teeth, *C—D* left teeth, some teeth reversed. *A*, *Bolodon osborni* Simpson, right P^1 and P^3—M^2, BM 47735A holotype; *Eobaatar magnus* sp. n., tentative reconstruction of right upper premolars and molars, based on isolated premolars and molars (GI PST 10—34, GI PST 10—35, GI PST 10—27, GI PST 10—45, GI PST 10—33, PIN 3101/62); *C*, *Monobaatar mimicus* sp. n., tentative reconstruction of left P^1—P^4 and M^2, based on fragmentary maxillae and isolated M^2 (PIN 3101/74, PIN 3101/65, PIN 3101/61); *D*, *Arginbaatar dimitrievae* Trofimov, tentative reconstruction of left upper premolars and molars based on fragmentary maxillae and isolated M^1 and M^2 (PIN 3101/54, PIN 3101/68, GI PST 10—36, PIN 3101/55, GI PST 10—20). Assignement of M^1 to *Arginbaatar* is highly tentative, it is described in text as Unidentified M^1.

specimen BM 47733 (pl. 8: 1). In spite of strong wear one can notice the similarity to *E. magnus* in the arrangement of cusps on M_2 In both species the lingual cusps are higher than the buccal and are crescentic, facing towards the medial groove. The lower molars are also known for *Ctenacodon* (pl. 11: 1, 3) and *Psalodon*, but these differ from *Eobaatar* in having buccal cusps well separated, without a tendency for coalescence characteristic of *E. magnus*. Another difference concerns the asymmetry of *E. magnus* lower molars in which the buccal row is longer than the lingual, while in *Ctenacodon* and *Psalodon* both rows of cusps in lower molars are more or less of the same length.

The upper premolars and molars of *Eobaatar magnus*, if correctly arranged in anatomical order are most similar to *Bolodon osborni* (fig. 3). The similarity concerns the structure of the anterior premolars which are either three or four-cusped with a well developed posterior cingulum; the structure of P^4, which in both species has two rows of cusps and additional cuspules; the structure of P^5, which in both species has two cusps in the buccal row but more additional cuspules in *Bolodon osborni* than in *Eobaatar magnus*. The upper molar are very similar in both species in general shape and type of ornamentation. The difference in M^2 is that in *E. magnus* there is an additional anterior cusp in the middle row, absent from *B. osborni*, but otherwise the shape of M^2 in both species is strikingly similar.

As upper teeth of *Eobaatar magnus* are similar to those of *Bolodon osborni*, while lower teeth to *Plagiaulax becklesii* it would be tempting to suggest that *Bolodon osborni* is a counterpart of *Plagiaulax becklesii*. Such a conclusion would, however, include circular reasonig, as we have reconstructed the sequence of upper teeth of *Eobaatar magnus* on the basis of a comparison with *Bolodon osborni*.

Family *incertae sedis*
Genus *Monobaatar* nov.

Type species: *Monobaatar mimicus* sp. n.
Etymology: Lat. *mono* — single, Mong. baatar — hero, the name refers to the single infraorbital foramen.

Diagnosis. — The genus is monotypic, the generic characters are those of the type species.
Occurrence. — Khovboor Beds (?Aptian or Albian), Khovboor, Guchin Us somon, Gobi Desert, Mongolia.

Monobaatar mimicus sp. n.
(pls. 3: 3; 7: 3; 9: 2, 3; fig. 3C)

Holotype: Left partial maxilla with P^2—P^4, broken posterior alveolus for P^1, anterior alveolus for P^5, PIN 3101/65.
Type horizon and locality: Khovboor Beds (?Aptian or Albian), Khovboor, Guchin Us somon, Gobi Desert, Mongolia.
Etymology: *Lat. mimicus* — imitating, resembling the species of *Arginbaatar* in the structure of upper premolars.

Diagnosis. — Estimated length of the skull is 2 cm. Single infraorbital foramen positioned above P^3—P^4 embrasure. Posteroventral margin of the base of zygomatic arch positioned above P^4—P^5 embrasure. P^1—P^3 three cusped. Cusps 3:4 on P^4, second cusp of the buccal row the largest. M^2 with 1:2:3 cusps. Cusps in M^2 relatively robust, anterior margin of M^2 weakly sigmoid. Cusps of premolars and molars ornameneted with weak striations, ridges finely granulated.

Material. — In addition to the holotype specimen we assign here: a fragmentary left maxilla with P^1 and P^2 PIN 3101/74; left ?P^4 GI PST 10—26 and tentatively left M^2 PIN 3101/61.

Reconstruction. — PIN 3101/74 is assigned to ***Monobaatar mimicus*** sp. n., because it has a single infraorbital foramen (broken) positioned above P^3—P^4 embrasure as in the holotype. The P^4 GI PST 10—26 is here assigned because of the strong similarity and comparable measurements to P^4 in the holotype. The assignment of M^2 PIN 3101/61 is tentative; it shows a similar fine granulation of the outer ridge as the anterior ridge of P^4 in GI PST 10—26 (less certain in the holotype specimen) and fine striations on the cusps, similar to those on P^4's and on the anterior premolars. In addition the M^2 is relatively wide, which corresponds better to the wide P^4 of *Monobaatar mimicus,* than to relatively narrow P^4 of ***Arginbaatar dimitrievae***, which is approximately the same size.

Description. — The maxilla is relatively robust with a single infraorbital foramen, 0.8 mm high in PIN 3101/65, positioned (posterior margin) above the P^3—P^4 embrasure. The zygomatic ridge is weak and encircles a narrow, nearly vertical area on the ventral part of the zygomatic arch. Along the ventral margin of the zygomatic arch there extends irregular rugosity, best seen in lateral view (pl. 3: 3a). The palatal part of the maxilla is arranged obliquely upwards with regard to the occlusal surface of the teeth, which shows that the palate was relatively highly vaulted. It is covered with numerous nutrient foramina.

P^1 (preserved in PIN 3102/74) is the largest of three anterior premolars, 3- cusped, without a posterior cingulum. It is 0.8 mm long and 0.7 mm wide.

P^2 is 0.6 mm long and 0.7 mm wide in the holotype specimen and 0.7 mm long and 0.7 mm wide in PIN 3101/74. It has three cusps and a minute posterior cingulum.

P^3 is lower than P^2 and therefore in the holotype specimen it is less worn. It is 0.6 mm wide and 0.6 mm long, has three cusps and a small, crescentic posterior cingulum. It appears smaller than P^2 in both lateral and occlusal views because it is partly obscured by both P^2 and P^4. The posterior cingulum is hardly seen in occlusal view. The buccal cusp is the largest, the first lingual cusp is the smallest.

P^4 is 1.3 mm long, 0.8 mm wide posteriorly and 0.6 mm wide anteriorly. It had 3:4 cusps; those of the lingual row have been completely worn out; only the traces of three buccal cusps are discernible. A distinct crest, directed slightly anteriorly, forms the anterior margin of the tooth; it joins the anterior cusps of the lingual and buccal rows. A roughly triangular area is left between this crest and strongly worn anterior buccal and lingual cusps. Of the three cusps of the buccal row the medial one is the largest. To the rear of the ultimate buccal cusp and lateral to the worn prolongation of the lingual row of cusps there is a small triangular area (pl. 3: 3d). The ornamentation of fine striae is preserved on the unworn part of the cusps. The anterior ridge is ornamented with fine cuspules.

GI PST 10—26 is 1.4 mm long (it is 0.1 mm longer than P^4 in the holotype), 0.86 mm wide across the posterior lingual cusp and 0.78 mm wide across the second lingual cusp. It is slightly longer lingually than buccally, the cusps in the lingual row increase in size posteriorly. A ridge extends from the ultimate lingual cusp to the posterior margin of the tooth (pointed at this place). The cusps of the lingual row are worn obliquely subvertically towards the lingual side. All other details are the same as in P^4 in the holotype specimen, including ornamentation of fine striae on the cusps and fine ornamentation on the anterior ridge. The apparent differences between P^4 of the holotype specimen (pl. 3: 3d) and GI PST 10—26 (pl. 9: 2a) are due to the different position in which these photographs have been taken. A direct microscopic comparison of booth teeth shows that they are almost identical and therefore we regard them as conspecific.

Left M^2 PIN 3101/61 (pl. 7: 3), tentatively assigned to *M. mimicus* is 1.2 mm wide and 1.3 mm long lingually. Cusp formula is 1:2:3. The anterior margin is straight opposite the wing and the medial row of cusps, and slightly convex anteriorly opposite the lingual row. The cusps are relatively bulbous; those of the lingual row are slightly connate at the bases. The last cusp of the lingual row is broken. The first cusp of the medial row is separated from the anterior margin by a wide groove. All the cusps are worn subhorizontally, in addition the cusps of the medial row are worn subvertically towards the middle groove. The wing (buccal cusp) is surrounded by a prominent ridge, which continues along the anterior margin of the tooth up to the medial groove. This ridge is finely ornamented. The unworn surfaces of all the cusps are ornamented with fine striations.

Discussion. — *Monobaatar* does not belong to the Arginbaataridae, which has two infraorbital foramina (see below). It might therefore belong to the Eobaataridae, unless a third, poorly known multituberculate family occurs in the Khovboor Beds assemblage.

The only known eobaatarid species of which the upper teeth are known is *Eobaatar magnus*. *E. magnus* differs considerably from *Monobaatar mimicus* primarily in the type of ornamentation, which in *E. magnus* consists of conspicuous striae and, in the case of M^2, of grooves and ridges, while in *M. mimicus* the striation is so fine that it is seen only under a high magnification, and there occurs a very fine ornamentation on some ridges absent from *E. magnus*. Other differences concern the structure of P^4, which in *E. magnus* has two rows of strongly ornamented cusps and additional lateral cuspules, while it is relatively narrower, with only two rows of cusps and no additional cuspules in *M. mimicus*. The diffrences concern also the cusp formula and the presence of a characteristic pointed anterior margin in P^4 of *M. mimicus*. There are also considerable differences in the structure of M^2. In addition to the differences in cusp formulae and ornamentation, there are important differences in shape. M^2 in *E. magnus* has a straight anterior margin, and the anterolateral wing does not protrude laterally over the outline of the tooth. In *M. mimicus* the anterior margin is bent anteriorly in front of the lingual row of cusps and the anterolateral wing protrudes considerably outwards. The M^2 in the two discussed taxa have in common the relatively bulbous cusps diferent from the much more slender cusps in M^2 of *Arginbaatar* sp.

Because of the above discussed differences we believe that *Monobaatar mimicus* and *Eobaatar magnus* are not congeneric. It, however, cannot be excluded that they both are members of the same family, the Eobaataridae. As the mandible and lower teeth of *Monobaatar mimicus* are not known, we prefer to classify *Monobaatar* for the time being in the family *incertae sedis*.

It is possible that *Monobaatar mimicus* is a counterpart of *Eobaatar minor*, to which it corresponds in size. However both taxa are poorly known, the lower molars of *Eobaatar minor* have yet to be found, an one cannot vanture an opinion on whether the ornamentation characteristic of upper premolars and molars of *Monobaatar mimicus* was also characteristic of *E. minor*. Therefore it would be risky to place *Monobaatar mimicus* and *Eobaatar minor* in the same taxon. For comparison with *Arginbaatar* see p. 31.

Suborder ?**Plagiaulacoidea**
Family **Arginbaataridae** Hahn et Hahn, 1983

Revised diagnosis. — Two infraorbital foramina, three lower and five upper premolars. Lower incisor completely covered with enamel. Canine present, P_1 peg-like, single-rooted; P_2 double-rooted, small in comparison with P_4 which is very large, fan-shaped, with limited enamel that covers only anterior and posterodorsal part of the crown. In the only known genus *Arginbaatar* P_4 rotates anteroventrally during the ontogeny over the worn P_3 and P_4, which in later ontogenetic stages disappear. P^4 similar to P^5; both have two rows of cusps. Lower and upper molars relatively narrow, with well separated conical cusps. Cusps smooth or weakly striated. Enamel gigantoprismatic.

Occurrence. — Khovboor Beds (?Aptian or Albian), Khovboor, Guchin us somon, Gobi Desert, Mongolia.

Genera assigned: *Arginbaatar* Trofimov, 1980 — family monotypic.

Discussion. — The Arginbaataridae differs in the structure of P_4, which is only partly covered with enamel and rotates during the ontogeny, not only from other families of the Plagiaulacoidea, but also from all other known multituberculates. For this reason it would warrant an inclusion into a suborder of its own, but as it is poorly known we place it tentatively in the Plagiaulacoidea. It shares with other Plagiaulacoidea the structure of the lower incisor, which is completely covered with enamel, and the presence of five upper premolars (although there are only four or even three upper premolars in some plagiaulacoid genera or species — Hahn 1977, Hahn and Hahn 1983). It differs from most plagiaulacoids genera in having three lower premolars, rather than four as in most plagiaulacoid genera (but three in *Plagiaulax* and *Henkelodon* — Simpson 1928, Hahn 1978, Hahn and Hahn 1983). It shares three lower premolars with the Eobaataridae which also occurs in the Khovboor Beds. Another common feature of the Arginbaataridae and Eobaataridae is gigantoprismatic enamel, which is characteristic of all the Taeniolabidoidea (except *Neoliotomus*) and of the Cimolomyidae (Carlson and Krause 1985, Fosse *et al.* 1985). The Arginbaataridae has two infraorbital foramina, which is a primitive feature (Hahn 1985). If *Monobaatar* gen. n., which has a single infraorbital foramen is an eobaatarid, then the Arginbaataridae and Eobaataridae would differ in the number of infraorbital foramina. The two infraorbital foramina are characteristic of the Kimmeridgian Paulchoffatidae, from which the Arginbaataridae differs considerably in many respects, especially in the structure of lower premolars, which are of a different pattern in the two families.

Genus *Arginbaatar* Trofimov, 1980

Type species: *Arginbaatar dimitrievae* Trofimov, 1980, the only species known.

Diagnosis and occurrence. — As for the family.

Arginbaatar dimitrievae Trofimov, 1980

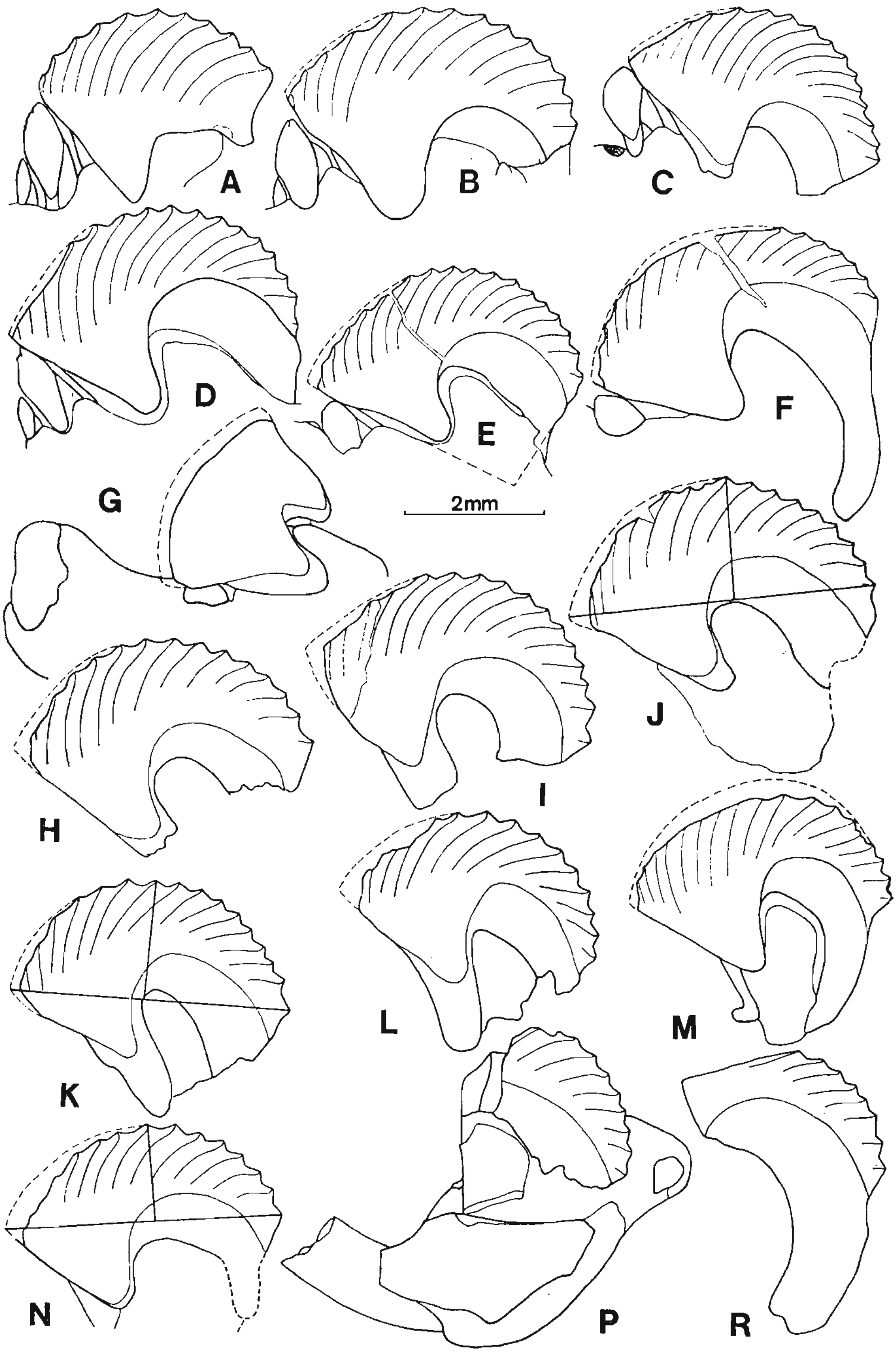
(pls. 7: 1, 2; 9: 1; 13—15; 16: 2, 3; 17: 1,2; 18—22; figs. 2E—G; 3D; 4; 5; 6A)

1980. *Arginbaatar dimitrievae* Trofimov: 210, fig. 1.

1983. *Arginbaatar dimitrievae* Trofimov; Hahn and Hahn: 46.

Revised diagnosis. — Estimated length of the skull 2 cm. P_2 peg-like, P_3 two cusped, its length equal to 1/7 that of P_4, which is strongly convex upwards, with 15—18 serrations; anterior root smaller than the posterior, both roots open. In early ontogenetic stages posterior part of P_4 obscured by bone. M_1 small, 2.7 times shorter than P_4, with 3:2 cusps. P^4 and P^5 nearly identical, with 3:4 cusps each. M^2 with 1:2:3 cusps and sigmoid anterior margin. Cusps in upper and lower molars slender, widely separated from each other. Premolar cusps with very weak striations.

Reconstruction. — The holotype specimen of *Arginbaatar dimitrievae* is a broken mandible with P_2—M_1. We assign to *A. dimitrievae* several fragments of mandibles with premolars or incisor, isolated P_4 and M_1. We also match with these mandibles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maxillae with premolars, isolated premolars and tentatively isolated M^2 on the following premises. In addition to *Eobaatar magnus* sp. n., which has relatively large, strongly ornamented premolars and molars, there are two types of maxillae with premolars in Khovboor Beds which may be matched with the mandibles of *Arginbaatar dimitrievae*, and which differ from each other in having a single or double infraorbital foramen. In the reviewed collections there are fifteen mandibular fragments with teeth, of which twelve (i.e., 80%) belong to *Arginbaatar dimitrievae*. There are also seven fragments of maxillae with premolars, of which five (71%) have two infraorbital foramina and two have a single infraorbital foramen. The premolars in both types are very similar to each other, but in forms with single infraorbital foramen P^4 is wider and has an ornamentation of fine striae and finely ornamented ridge, which we also find in a relatively wide M^2 with bulbous cusps. M_1 in *A. dimitrievae* is relatively narrow and has slender, non-ornamented cusps. The same type of cusp occurs in relatively narrow upper molars which we tentatively regard as conspecific with the lowers of *A. dimitrievae*. Taking all of this into account we think that it justified to assign the maxillae with double infraorbital foramina to *Arginbaatar dimitrievae*, while forms with a single intraorbital foramen we have described as *Monobaatar mimicus* gen. n., sp. n.

Material. — *PIN collection. Mandibles and lower teeth.* The holotype specimen PIN 3101/49 was characterized by Trofimov (1980) as the right mandible with incisor and P_2—M_1; Trofimov figured it as having the incisor *in situ*. The holotype specimen which was borrowed from PIN and taken to ZPAL to be photographed there, is figured in pl. 13. It has a very long incisor surrounded on three sides by bone. An examination of the specimen showed that the incisor has been glued too far anteriorly to the mandible and that it probably belongs to the left counterpart of the right holotype mandible, in which the incisor has not been preserved. 3101/51 fragment of right mandible with P_2—P_4; 3101/52 fragment of right mandible with broken incisor and posterior part of P_4; 3101/56 fragment of left mandible with alveolus for P_2, reduced P_3 and P_4 turned over P_3; PIN 3101/58 fragment of right mandible with strongly worn anterior part of P^4 turned over strongly reduced P^3, alveolus for incisor; 3101/59c anterior part of left P_4; 3101/71a right P_4; 3101/71b right P_4; 3101/71c left P_4; 3101/73a left P_4 with fragment of mandible; 3101/73b posterior part of strongly worn P_4; PIN 3101/73c fragment of P_4; 3101/73d fragment of P_4; 3101/73e fragment of P_4; 3101/73f fragment of P_4; 3101/73g fragment of left P_4; 3101/73h broken right P_4; 3101/50c right M_1; 3101/50d left M_1.

Maxillae and upper teeth. 3101/50a right M^2 associated with left P^x (?P^2 or P^3) 3101/50b left P^1; 3101/54 fragment of left maxilla with P^1—P^3 figured by Trofimov (1980), left M^2, 3101/61, 3101/68 fragment of right maxilla with P^1—P^4; 3101/69 fragment of right maxilla with P^2—P^3; 3101/72 fragment of left maxilla with P^2—P^3.

GI collection. Mandibles and lower teeth. PST 10—4 posterior fragment of hight P_4; PST 10—11 fragment of right mandible with P_2, P_3 and anterior part of P_4; PST 10—12 fragment of left mandible with alveolus for P_2, reduced P_3, P_4 turned over

Fig. 4. Comparison of P_1—P_4 or single P_4's in buccal view of fifteen specimens of *Arginbaatar dimitrievae* Trofimov from Khovboor Beds (?Aptian or Albian) in Khovboor, Guchin US somon, Gobi Desert, Mongolia). *A*, GI PST 10—11; *B*, PIN 3101/49 holotype reversed, posterior part of P_4 reconstructed on the basis of lingual side; *C*, GI PST 10—40 reversed; *D*, PIN 3101/51 reversed; *E*, GI PST 10—12; *F*, PIN 3101/56; *G*, PIN 3101/58 reversed; *H*, PIN 3101/71; *I*, GI PST 10—13 reversed; *J*, GI PST 10—60; *K*, PIN 3101/71b reversed; *L*, PIN 3101/71a reversed; *M*, GI PST 10—41 reversed; *N*, PIN 3101/73a; *P*, PIN 3101/52 reversed; *R*, PIN 3101/73b. The lines in figs. *J*, *K* and *N* show how the estimated lengths of P_4 and length to width ratio were measured. Figs. *A*—*D* are arranged into more or less ontogenetic sequence, showing the various stages of rotation of P_4 and reduction of P_3 and P_2.

P_3; PST 10—13 right P_4; PST 10—31 posterior part of right P_4; PST 10—40 fragment of right mandible with P_3, P_4 and alveolus for P_2; PST 10—11 right P_4 with fragment of mandible; PST 10—60 left P_4 with fragment of mandible; PST 10—42 right M_1; PST 10—44b right M_1.

Maxillae and upper teeth. PST 10—15 right maxilla part of zygomatic arch and P^5; PST 10—20 left M^2; PST 10—36 right ?P^5, PST 10—44a left ?P^5 (tentatively assigned).

Description. — The mandible, when seen in dorsal view, is at the level of the anterior root of P_4 bent inwards at an angle of 140° (fig. 6a). The anterior part of the mandible (beginning with anterior root of P_4) is directed anteromedially. On the buccal side in the place of bending there is a distinct swelling below P_4. The upper margin of the mandible in front of P_1 is directed forwards and upwards. In PIN 3101/58 the length of the diastema between P_2 and incisor (P_1 in this specimen has disappeared) measures 1.7 mm. As the upper margin of the incisor's alveolus is in this specimen thickened, it appears that the preserved alveolus (broken on lingual side) is the real one. In the middle of the diastema, 0.7 mm below the upper margin there is a small, round mental foramen 0.1 mm in diameter. The mandible measures 2.4 mm below the diastema and 2.6 mm below the anterior root of P_4 in GI PST 10—40, which belonged to a young individual, and 2.8 mm below the anterior root of P_4 in PIN 3101/56. The coronoid process starts opposite M_2. It was possibly low and steep. Anteroventrally it prolongs on the buccal side of the mandible as a rounded ridge that disappears below the posterior root of P_4. This ridge surrounds the shallow masseteric fossa dorsally. Only the anterior part of the masseteric crest has been preserved in PIN 3101/56. On the lingual side the dorsal part of the mandible in front of the anterior root of P_4 is concave, which is connected with bending of the mandible in this place. The partly broken symphyseal area has been preserved in PIN 3101/58 (pl. 20: 5a). It is roughly bean-shaped. It is arranged parallel to the posterior part of the mandible, rather than to the bent anterior one and therefore it is figured obliquely in pl. 20: 5a.

Lower teeth. Lower incisor is preserved only in PIN 3101/49 (but see Material) and PIN 3101/52 (pl. 13 and 18: 4). It is uniformly covered with a thin layer of enamel. It is directed upwards (in the photograph on pl. 18: 4 the lower margin on the mandible is across the left bottom corner). It is oval in cross section, 1 mm high and about 0.5 mm wide in PIN 3101/53. In PIN 3101/49 it narrows slightly anteriorly, being in the most anterior part 0.85 mm high.

P_2 has been preserved only in GI PST 10—11, PIN 3101/49 and PIN 3101/51. It is a single-rooted tooth, cone like and narrowing upwards in buccal and in lingual views, but roughly trapezoidal when seen in anterobuccal view. In this latter view it is very narrow above the root, then widens to two thirds of its height and dorsally narrows again. In GI PST 10—11, which belonged to a young individual, P_2 is the largest and measures 0.7 mm, while only 0.4 mm in PIN 3101/49 and 0.5 mm in PIN 3101/51 (see Variability of Lower Premolars).

P_3 has been preserved in seven specimens (fig. 4A—G) but only in three of them: GI PST 10—11, PIN 3101/49, and PIN 3101/51 (fig. 4A, B, D) does it retains its adult shape and size, while in other specimen it is strongly reduced (see Variability of Lower Premolars). It is a two-rooted tooth, with roots placed obliquely with regard to the length of the mandible, anterior one on the buccal side, the posterior one slightly behind it on the lingual side. In buccal view the tooth is roughly trapezoidal, very narrow above the anterior root (resembling the exonaeodont lobe above the anterior root of P_4), then it widens upwards to more than two thirds of its height, and narrows upwards again. On the top and immediately anteroventral to it along the anterior margin, there are two minute cuspules. To the rear of the trapezoid, in buccal view, the posterior root and part of the posterior wall of the tooth is visible. In lingual view P_3 has also a roughly trapezoidal shape but the ventral margin of the trapezoid (above the posterior root) is less prominent than on the buccal side.

Lenght and width of the trapezoid measured in buccal view is respectively: GI PST 10—11: 1.4 mm and 0.57 mm; PIN 3101/49: 1.3 mm and 0.5 mm; PIN 3101/51 1.4 mm and 0.5 mm.

P_4. Nearly complete P_4's have been preserved in thirteen specimens, all of which are figured in fig. 4, while fourteen specimens, four of which are figured in fig. 4, are fragmentary. P_4's in *A. dimitrievae* vary considerably in size and shape. We base our description primarily on GI PST 10—12 (fig. 4E and pl. 15: 1) as this tooth is well exposed from both buccal and lingual sides and is more or less average in size and shape. We comment on other P_4's under Variability of Lower Premolars. We do not base our description on P_4 of the holotype specimen, as this P_4 is partly obsured by bone. As all the P_4's are worn or incomplete it was difficult to measure them. In this situation we give only their estimated dimensions (see Table 1 and Variability).

Buccal side. — GI PST 10—12 P_4 is fan-shaped, strongly convex upwards; its outer outline is wider thant half of a circle. The prolongations of the anterior and posterior margins of the tooth (fig. 4E) meet at an angle of 98°. The length of the tooth measured between the estimated position of the first and the last serrations is 4 mm. There are eighteen serrations, the first six of which are worn. The distances between the serrations are, on average, 0.33 mm. All serrations are provided with ridges. The ridges of the eight middle serrations are longer than those of the anterior and posterior ones. The ridge of the ultimate serration is very short and measures only 0.17 mm. The enamel covers the entire exodaenodont lobe and the posterodorsal part of the crown. The exodaenodont lobe is roughly triangular, but its ventral margin is rounded. The posterior margin of the exodaenodont lobe which forms the limit of the enamel on the lobe, continues over the crown in a bow convex upwards, marking the boundary between the enamel and the enamel-free surface. It reaches the posterior margin of the tooth 0.5 mm behind the last serration. The ventral margin of the tooth between the posterior boundary of the exodaenodont lobe and the anterior boundary of the enamel-free area is roughly parabolic. The enamel-free area is gently convex, especially in its medial part, which prolonges

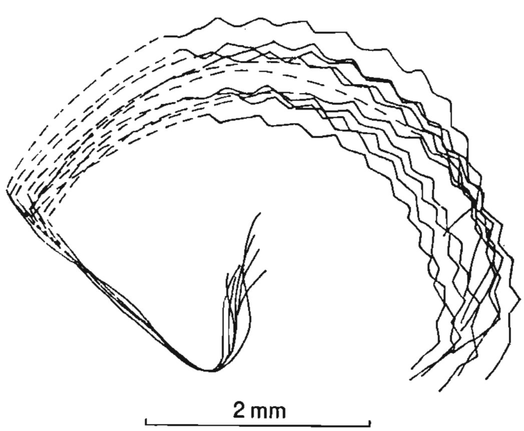

Fig. 5. Camera lucida drawings of *Arginbaatar dimitrievae* Trofimov. Eleven buccal profiles of P_4's superimposed, with anterior margins aligned.

posteriorly into the posterior root. The root is bent; it is 0.8 mm wide at the base and narrows downwards. The anterior root cannot be examined in GI PST 10—12. It is well exposed in some isolated P_4's and it usually measures 0.6 mm in width. Only in GI PST 10—41 are both anterior and posterior roots exposed. This specimen shows that anterior root is narrower than the posterior, it is 0.6 mm wide, while the posterior one is 1 mm. Both roots are open.

Lingual side. — The crown on the lingual side is lower than on the buccal. This is particularly true for the anterior part where the ventral margin of the crown is rounded and is continuous with the ventral margin between the roots. The ridges are similarly developed as on the buccal side and the size of the enamel-free area is similar. To the rear of the ultimate cusp the enamel-free area is concave, at the boundary with median convexity which passes into the posterior root.

Dorsal view. — As usual in multituberculates, the P_4 is compressed laterally and is narrow in dorsal view. It is narrowest medially. Its outline flares buccally in the area of the exodaenodont lobe, and less conspicuously on both sides opposite the posterior root.

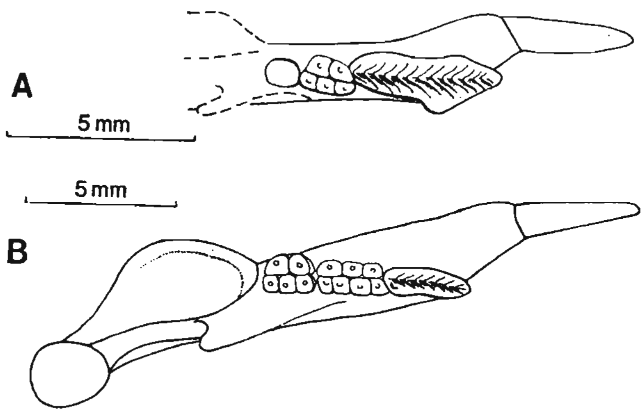

Fig. 6. Comparison of mandibles of: *A*, ***Arginbaatar dimitrievae*** Trofimov and *B*, ***Kryptobaatar dashzevegi*** Kielan-Jaworowska in occlusal view. Notice that the mandible of ***Arginbaatar*** below the anterior root of P_4 is bent medially. P_2 and P_3 of ***Arginbaatar*** are in this view obscured by P_4. ***Arginbaatar*** based on PIN 3101/49, *Kryptobaatar* redrawn from Kielan-Jaworowska and Dashzeveg (1978).

Anterior view. — The anterior side of P_4 may be examined only on isolated teeth (e.g. in GI PST 10—12, pl. 19: 2). The anterior root in this view is concave and is slightly wider than in buccal view (e.g. in PIN 3101/59 it measures 0.6 mm in buccal view and 0.7 in anterior view). It has a longitudinal medial ridge. Dorsally the crown forms and asymmetrical roof above the root, longer buccally (formed by the anterior margin of the exodaenodont lobe) than lingually.

M_1. Right M_1 has been preserved *in situ* in the holotype specimen (fig. 2 and pl. 13 and 14: 1c). In addition, four isolated M_1's occur in both collections (fig. 2E—G, and pl. 20: 1—4). The measurements of these teeth are given in Table 2. Cusp formula is 3: 2. The cusps are conical, clearly separated from each other by wide grooves. The tooth is longer buccally than lingually and both anterior and posterior margins are oblique with regard to the long axis of the tooth, the anterior one more strongly so. There are no traces of ornamentation.

Table 1

Arginbaatar dimitrievae Trofimov
Estimated lengths of P_4 and of the anterior margin of the exodaenodont lobe (in mm)

Mus. cat. no.	Length of P_4	Length of exodaeno-dont lobe (anterior margin)
PIN 3101/71a	3.8	2.2
GI PST 10—40	3.9	2.1
GI PST 10—12	4.0	2.2
PIN 3101/71b	4.0	2.1
PIN 3101/73a	4.0	2.06
PIN 3101/49	4.2	2.6
PIN 3101/51	4.2	2.5
PIN 3101/56	4.2	2.3
GI PST 10—60	4.2	2.2
GI PST 10—13	4.3	2.3
PIN 3101/71c	4.4	2.5

Table 2

Arginbaatar dimitrievae Trofimov

Mus. cat. no.	Measurements of M_1 in mm	
	Length	Width
GI PST 10—42	1.45	0.9
GI PST 10—44b	1.5	0.9
PIN 3101/50c	1.4	0.95
PIN 3101/50d	1.47	0.96
PIN 3101/49	1.49	0.91

M_2 is not known.

Maxilla. (pls. 21 and 22) The snout opposite the anterior premolars is slender, the zygomatic arch flares laterally opposite P_4, its posterior margin being positioned in ventral view opposite the very posterior part of P_5 behind the last cusp. The zygomatic ridge is poorly developed and encircles a narrow, nearly vertical surface. There are two infraorbital foramina, in PIN 3101/54. The anterior one is 0.8 mm high, positioned higher than the posterior one, opposite P^3—P^4 embrasure. The posterior infraorbital foramen is 0.4 mm high and positioned opposite the posterior part of P^4. In PIN 3101/68 both foramina are situated slightly more anteriorly. In PIN 3101/54 and partly in PIN 3101/68 the anterior margin of the palatal part of the maxilla corresponds to the premaxillary-maxillary suture and is gently convex posteriorly. The palatal part of the maxilla is concave upwards, but less vaulted than in *Monobaatar mimicus* sp. n.; it is covered with numerous nutrient foramina.

Upper teeth. (fig. 3D)

Canine. In PIN 3101/68 the small broken part of the premaxilla is preserved in front of the maxilla and in the area of the suture a part of the alveolus (possibly for a canine) has been preserved.

Table 3

Arginbaatar dimitrievae Trofimov. Measurements of upper premolars and M^2 in mm. (The specimens with strongly worn teeth have not been measured; M^1 is not known)

Mus. cat. nos.	P^1		P^2		P^3		P^4		P^5		M^2	
	l	w	l	w	l	w	l	w	l	w	l	w
I. PIN collection 3101/54 left maxilla with P^1-P^3	1.0	0.9	0.85	0.85	0.85	0.8						
3101/50b left P^1	0.8	0.85										
3101/68 right maxilla with P^1—P^4	0.8	0.75	0.8	0.8	0.8	0.7	1.3	0.8				
3101/50a right M^2 and left P^1 P^2 or P^3			0.77	0.8							1.45	1.15
II. GI collection PST 10—15 right maxilla with P^5									1.2	0.8		
PST 10—36 right ? P^5									1.2	0.85		
PST 10—44a left ? P^5									1.2	0.75		
PST 10—20 left M^2											1.3	1.0

P^1 is situated a short distance behind the premaxillary-maxillary suture, which in PIN 3101/54 measures 0.4 mm buccally and 0.2 mm lingually; in PIN 3101/68 this distance may be shorter. It is the tallest of the first three premolars, 3-cusped (see Table 3 for dimensions), the buccal cusp is larger than the two lingual ones, the buccal and first lingual are more bulged than the second lingual cusp. There is no posterior cingulum but there is a ridge which joins the buccal cusp with the second lingual.

P^2 differs from P^1 in the presence of a ridge that joins the buccal cusp with the first lingual cusp and in the presence of a minute posterior cingulum, also provided with a ridge, and placed more lingually than buccally along the posterior margin.

P^3 is similar to P^2 but longer because of the presence of more prominent posterior cingulum. The posterior margin of the tooth in occlusal view has a petaloid shape, consisting of two crescents: around the posterior cingulum and around the buccal cusp.

P^4 has 3:4 cusps and is shorter buccally than lingually. The posterior margin is pointed opposite the lingual row of cusps. The cusps in the lingual row increase in size posteriorly, in the buccal row the first one is the smallest, the medial one slightly larger than the posterior one. The anterior margin opposite the buccal row is developed as a ridge, which is slightly enlarged and may be interpreted as an incipient additional cusp of the buccal row (see pl. 21: 1b). To the rear of the last cusp of the lingual row there is a longitudinal ridge that extends to the pointed end of the tooth. The lingual wall of the tooth forms a smooth shearing surface, the highest (and flaring somewhat lingually in occlusal view) opposite the posterior root. In PIN 3101/68 the lingual cusps are worn subhorizontally, slightly obliquely towards the lingual side.

P^5 preserved in GI PST 10—15 is nearly identical with the above described P^4, from which it differs only in the development of the anterior ridge of the tooth, which is here smooth, rather than forming and incipient cusp as in P^4. Two isolated ?P^5' GI PST 10—44a and GI PST 10—36 (pls. 9: 1 and 21: 3 respectively) which we also assign to *A. dimitrievae* (the first of them tentatively) are similar to the above described P^5 but they are slightly shorter. They differ from each other slightly in proportions, GI PST 10—44a is more slender than GI PST 10—36; all other details of the three teeth are identical. All of the above described premolars have very fine striations on the cusps, more prominent on P^4 and P^5 than on P^1—P^3, which are almost smooth.

M^1 is not known.

M^2. Two M^2's (pl. 7: 1 and 2a) are tentatively assigned to *A. dimitrievae*. Cusp formula is 1:2:3. Anterior margin of the tooth is sigmoid, protruding sharply anteriorly opposite the middle groove. The outer cusp (wing) protrudes laterally over the outline of the tooth. The medial groove is relatively very wide; the cusps are slender, conical, clearly separated from each other. The outer cusp was probably surrounded by a ridge, which anteromedially continued as the anterior ridge. In both specimens the outer and anterior ridges are strongly worn, it however, appears possible that the anterior ridge was enlarged opposite the first cusp of the medial row (in PIN 3101/50a there is a small cuspule in this place). In GI PST 10—20 the worn surface of the outer ridge passes on the outer surface of the second medial cusp. The cusps of the inner row are worn towards the median groove. The ridge joins the first cusp of the inner row with the anterior margin and another ridge joins the last cusp of the same row with the posterior margin. There is no trace of ornamentation. The apparent additional cuspule in the inner row of GI PST 10—20 in pl. 7: 1b is an artefact.

Variability. — As the upper teeth, lower premolars and molars in *A. dimitrievae* are not numerous, we confin our discussion on the variability to the lower premolars.

The P_4's in multituberculates generally show a great degree of variability (see e.g. Novacek and Clemens 1977, Krause 1977, 1982*a*, Johnston and Fox 1984) and this is the case with P_4 of *Arginbaatar dimitrievae.* Within various aspects of variability we recognize: 1. individual variation in the size and shape of the tooth, in size and shape of the exodaenodont lobe, in the number of serrations and ridges connected with them, in the shape of the enamel-free area and in the size of the roots, and 2. ontogenetic variation in the position of P_4 in the mandible in relation to P_3 and P_2, in the degree on the wear on P_2 and P_3 and their resorption, in the degree of wear along the apical margin and on the buccal side of P_4 and in the degree of bending of the roots of P_4.

Individual variation. To study the variation in size of P_4 we measured its length from the first to last serration on the buccal side. All the P_4's in our collection belong to adult or old individual, as they have the anterior part of the apical margin of the tooth more or less strongly worn. In consequence the first serration is not completely preserved in any of the complete teeth and its position (and hence the shape of the anterior part of the tooth) had to be in all the cases reconstructed, which involves a great degree of uncertainty as far as the accuracy of the measurement is concerned. In spite of this ambiguity we give estimated lengths for complete P_4's, in Table 1, except GI PST 10—41 which is too strongly worn.

The P_4's differ considerably in proportions. PIN 3101/73a and GI PST 10—40 are the lowest with regard to its length; the line that joins the anterior and posterior serrations passes in these teeth along the crown, above its lower margin; PIN 3101/71b is more vaulted and the line that joins the anterior and posterior serrations passes here below the lower boundary of the crown, between the roots. PIN 3101/71a is still more vaulted with respect to its length, altough the longitudinal line passes here just at the lower boundary of the crown. The height to length ratio measured as shown in fig. 4J, K, N varies from 0.34 (GI PST 10—40) to 0.44 (PIN 3101/71a) in all studied P_4's specimens.

In fig. 5 the buccal apical profiles of P_4 are superimposed, with anterior and ventral margins of exodaenodont lobes aligned. Although they show a considerable variation in size and shape, the differences are continuous and do not allow us to recognize more than one species of *Arginbaatar* in the studied collection.

The exodaenodont lobe varies in shape. It is relatively large and wide in the holotype specimen — PIN 3101/49 and in PIN 3101/51, PIN 3101/56 and GI PST 10—60 but relatively narrow in PIN 3101/71a and PIN 3101/71b.

The number of serrations varies from 14 to 18 and there are also minute differences in distances between them. The enamel-free area on the buccal side is more convex in highly vaulted specimens (e.g. in all figured in pls. 18 and 19) than in PIN 3101/49 and PIN 3101/56 (pls. 13, 14: 1 and 15: 2). Lastly, there are differences in the shape and length of the posterior margin — to the rear and downwards of the ultimate serration (measured to the boundary of the enamel-free area). The margin may be straight, sigmoid, or concave, and from 0.3 mm to 0.7 mm long. The width of the posterior root at the base varies from 0.6 to 1.1 mm. It lies either in prolongation of the entire enamel-free area, or only in the prolongation of its median part. The posterior root is the largest in PIN 3101/73b, which belonged to an old individual; it is possible that the ever-growing root in this individual became enlarged.

Ontogenetic variation. During ontogeny P_4 appears to have rotated anteroventrally over P_3 and P_2, which coeval with the wear of the apical margin and of the buccal side of P_4, and the wear and resorption of P_3 and P_4, causes important differences in shape and position of these teeth with regard to each other and with regard to the mandible, at various ontogenetic stages. In fig. 4A—G we figure the lower premolars associated with fragmentary mandibles, arranged in a series that vaguely correspond to the ontogenetic sequence.

GI PST 10—11 (fig. 4A and pl. 14: 2) probably belonged to the youngest individual among the representatives of *A. dimitrievae*. The anterior part of the upper apical margin of P_4 is only slightly worn in this specimen. The anterior serrations on P_4 are somewhat less sharp than the more posterior ones, but still quite distinct and on P_3 the two cusps are preserved. The next stage is represented by three specimens each of which are worn in a different way — PIN 3101/49, GI PST 10—40 and PIN 3101/51 (figs. 4B, C, D and pls. 13; 14: 1; 17: 2; 16: 2 respectively). In all three specimens the anterior part of the apical margin of P_4 is worn, but while in PIN 3101/49 and PIN 3101/51 the upper margin of P_4 overhangs P_3 (and P_2), which are (especially P_3) slightly worn, in GI PST 10—40 the anterior margin of P_4 and the dorsal margin of P_3 are worn to form a continuous slicing edge together. In spite of wear the P_3 remains high, but its cusps are hardly discernible. The next stage is found in GI PST 10—12 and PIN 3101/56 (figs. 4E and F and pls. 15: 1 and 15: 2 respectively). In GI PST 10—12 the P_4 is more strongly overturned over the worn and possibly partly resorbed P_3; the P_2 is still present but is reduced to a small nubbin. In PIN 3101/56 P_3 is similarly reduced, while P_2 has disappeared. In both specimens the P_3's are reduced to less than half of the height of P_3 in GI PST 10—12 and there are no traces of cusps on them. Not only the most anterior but also the middle part of the apical margin of P_4 appears to be worn, especially in PIN 3101/56. In this specimen on the buccal side there is a worn area on the enamel-free surface. The posterior root in both specimens is strongly bent, showing the direction of tooth movement. The last stage is represented by PIN 3101/58 (fig. 4G and pl. 20: 5), in which the P_4 is completely turned over the worn P_3. The anterior margin of the exodaenodont lobe lies along the upper margin of the mandible. The apical margin of P_4 is completely worn and smooth without any traces of serrations. Also the surface of the exodaenodont lobe is heavily worn and no trace of ridges is preserved. The P_2 has been completely resorbed and is not seen on the jaw, while P_3 is almost entirely resorbed and is reduced to a small plate below the overturned P_4.

In all the isolated P_4's the anterior part of the apical margin is more or less strongly worn, but in some specimens, e.g. in GI PST 10—41 the middle part of the apical margin also is worn, as is the buccal side, in particular the exodaeonodont lobe (fig. 4M, and pls. 18: 2 and 19: 3). In this specimen the shape of the anterior and posterior roots (both open) clearly shows the mode of tooth growth. The posterior root (larger) is bent showing the direction of tooth rotation during ontogeny. When the tooth rotated there was not sufficient room for the first root, which (as may be expected) became bent and has its tip bent under a right angle. PIN 3101/73b (fig. 4R and pl. 16: 3) possibly represents a very old ontogenetic stage, having the top party of the crown heavily worn.

Discussion. — The lower teeth of *Arginbaatar dimitrievae* and in particular P_4 differ so dramatically from those of all other multituberculates and among them from those of *Eobaatar* that they do not invite a comparison. Among the multituberculate species that occur in the Khovboor Beds it also easy to tell the upper premolars of *A. dimitrievae* from those of *E. magnus*, because of considerable difference in size and because of the conspicuous ornamentation of the latter taxon. *A. dimitrievae* is of approximately the same size as *Monobaatar mimicus*. The maxillae of these species differ in number of infraorbital foramina (two in *Arginbaatar* and one in *Monobaatar*) in the position of the base of zygomatic arch, the posteroventral margin of which is placed in *Arginbaatar* opposite the very posterior part of P^5, while opposite the P^4—P^5 embrasure in *Monobaatar*, and in the structure of the palatal part of maxilla, which is more highly vaulted in *Monobaatar* than in *Arginbaatar*. The assignment of isolated upper premolars to one or other taxa may pose difficulties. Three anterior premolars are three- cusped and only slightly larger in *A. dimitrievae* (fig. 3C, D); they appear more prominently ornamented in *M. mimicus* than in *A. dimitrievae*, where they are almost smooth, but the difference is not dramatic. P^4 (and possibly also P^5) appear also more conspicuously ornamented and relatively longer and wider in *M. mimicus* than in *A. dimitrievae*, but the differences are not great. It seems also that the anterior ridge of P^4 (and possibly also P^5) protrudes more strongly anteriorly and is finely ornamented in *Monobaatar*, while rather smooth in *Arginbaatar*, but this difference may not be the case, as it may be a subject of individual variation, especially that in PIN 3101/68 of *A. dimitrievae* there is a minute cusp on this ridge. In spite of these similarities we assign some isolated premolars to one or to the other species, but we regard these assignments as tentative.

The upper premolars of *Arginbaatar* in the arrangement of cusps and lack of prominent ornamentation are more similar to those of *Ctenacodon* than *Bolodon*. An examination of the cast of the maxilla of *Ctenacodon laticeps* YPM 11761 shows that in this species two infraorbital foramina are present. The anterior one, larger (broken) is situated above P^2, higher than the posterior one, situated above P^3 (pl. 11: 4). Only the posterior one of these foramina was described by Simpson (1928). In *Arginbaatar* also the anterior infraorbital foramen is situated higher than the posterior one and is larger, but both foramina are placed more posteriorly than in *Ctenacodon*.

Unidentified teeth

Unidentified upper incisor

(pl. 9: 4)

Description. — GI PST 10—29 is the left two-cusped upper incisor. The preserved part is 3 mm long, it is 0.55 mm wide in the upper part and 0.8 mm wide across the posterior cups. The tooth is gently convex on both lingual and buccal sides, compressed laterally. There is a distinct groove extending from the base of the second cusp upwards, on both sides of the tooth, deeper on the lingual side. On the first cusp there is a distinct wear facet directed posterolingually. The enamel is gigantoprismatic. There are gentle striations similar to those on P^4 and P^5 of *Monobaatar mimicus* and *Arginbaatar dimitrievae*. The tooth may belong to either of these two species, but possibly to *A. dimitrievae*.

Unidentified M^1

(pl. 6: 1 and 2)

Description. — Two left M^1 PIN 3101/55 and GI PST 10—63 are conspecific. The cusp formula is 3:4. Both teeth are 1.3 mm long and 0.73 mm wide. The tooth is roughly quadrangular in occlusal view with a small posteromedial crescentic wing, positioned between the penultimate and ultimate cusps of the inner row. In GI PST 10—63 the wing is strongly worn. The cusps of the outer row are positioned between the cusps of the inner row. All cusps are strongly worn horizontally in both specimens. Because of strong wear no traces of ornamentation are preserved.

The described teeth are very narrow and therefore correspond better to M^2 and P^4 and P^5 attributed by us to *Arginbaatar dimitrievae* than to the wider M^2

and premolars of *Monobaatar mimicus*. The assignment of these teeth to *A. dimitrievae* cannot be demonstrated unequivocally and therefore we describe them as unidentified M^1's.

REMARKS ON MASTICATION

Few studies have been done so far on the mode of mastication in multituberculates. The paper by Krause (1982*b*) on jaw movement and dental function in *Ptilodus* is a notable exception. Hahn (1969, 1971, 1977) suggested that the flat wear facets on the lower premolars of Kimmeridgian paulchoffatiids indicate that these teeth made direct contact with the upper premolars and functioned with the molars in grinding and crushing. In a number of paulchoffatiid specimens (assigned to different species and genera) both premolars and molars are strongly worn, often leaving no traces of cusps. This type of wear was not known in post-Kimmeridgian multituberculates. In Purbeckian and Morrison Formation Plagiaulacidae strong wear has not been observed (Simpson 1928, 1929 see also pls. 10—12 in this paper). The difference may be due in part to different taphonomic conditions at the three localities, which in the Kimmeridgian of Portugal favoured the survival and preservation of old individuals, while in collections from Purbeck of Durleston Bay and from the Morrison Formation of Como Bluff young individuals prevail.

The study on the orientation of wear striations in Khovboor multituberculates and interpretation of their dental function will be the subject of a forthcoming paper. The flat wear surfaces on the upper premolars in older individuals in *Monobaatar mimicus* (pl. 3: 3) and on upper and lower premolars of *Arginbaatar dimitrievae* (pl. 22: 3, 4; 15: 2; 16: 2, 3; 17: 2 and others), as well as on the lower premolars in *Eobaatar magnus* (pl. 1: 4) indicate a strong crushing action similar to that in the Paulchoffatidae. The worn buccal surfaces in P_4 in *Arginbaatar dimitrievae* (pl. 15: 2; 18: 2; 19: 3b and 20: 5b) and in *Eobaatar minor* (pl. 8: 3b) indicate actions associated with heavy grinding as the buccal surface of P_4 sheared past the lingual surfaces of P^5 and M^1.

CONCLUDING REMARKS

In the assemblage of Early Cretaceous multituberculates from the Khovboor Beds in Mongolia there are two discrete groups: the Eobaataridae nov., assigned to the Taeniolabidoidea and the Arginbaataridae Hahn and Hahn, assigned tentatively to the Plagiaulacoidea.

The assignement of the Eobaataridae to the Taeniolabidoidea is based on the structure of the lower incisor with its limited enamel band, which is the principal diagnostic feature of the Taeniolabidoidea. In spite of this subordinal assignment, the Eobaataridae shares many characters with the Plagiaulacidae: in the number and arrangement of premolars it is on a plagiaulacoid rather than taeniolabidoid level of development.

The Purbeckian *Bolodon elongatus* from Great Britain has a single infraorbital foramen (Simpson 1928). We have argued that *B. elongatus* (but not *B. crassidens*) may belong to the Plagiaulacidae. If *Monobaatar* described here from the Khovboor fauna, belongs to the Eobaataridae, then this family also has a single infraorbital foramen. A single infraorbital foramen is characteristic of Taeniolabidoidea and Ptilodontoidea except in some rare forms in which it apparently became secondarily divided.

The Eobaataridae has three lower premolars arranged as in *Plagiaulax*. *Plagiaulax*, however, retains a row of basal cusps on P_4, while there is only a single basal cusp in the Eobaataridae, as is characteristic of Late Cretaceous (and Tertiary) Taeniolabidoidea and Ptilodontoidea (again with some derived exceptions). The P_4 is roughly rectangular in the Eobaataridae, as in the Plagiaulacidae, while in the Late Cretaceous Taeniolabidoidea it is more or less arcuate and overhangs the strongly reduced P_3. There are five upper premolars in the Eobaataridae, as is characteristic of the Plagiaulacidae, and the arrangement of these teeth (see fig. 3) is probably similar. However, the P^5 in *Eobaatar magnus* with only two buccal cusps placed anteriorly and a row of shearing lingual cusps, is reminiscent of the relatively narrow shearing P^4 of Taeniolabidoidea (which evidently is a homologue of P^5 in the Plagiaulacidae and Eobaataridae). Thus both upper and lower premolars in the Eobaataridae are in many respects intermediate between those of the Plagiaulacidae and Late Cretaceous and Tertiary Taeniolabidoidea. Changes parallel to those of the Taeniolabidoidea also occurred in the Ptilodontoidea and it seems possible that both of these suborders have their ancestors among the Plagiaulacidae. British Purbeckian (pl. 10: 2) *Plioprion? falconeri*, with a slender lower incisor may be regarded as lying close to the ancestors of Ptilodontoidea.

Another character that may throw light on the relationships among the multituberculate suborders and families is the enamel microstructure. Fosse *et al.* (1985) demonstrated that the enamel in the Kimmeridgian Paulchoffatiidae is preprismatic, while in both advanced multituberculate suborders: Taeniolabidoidea and Ptilodontoidea it is prismatic, but differs in the size of prisms. They called the enamel with large prisms occurring in Taeniolabidoidea (and *Meniscoessus*) gigantoprismatic. At the same time Carlson and Krause (1985) studied the enamel microstructure in all ptilodontoid and numerous taeniolabidoid genera and came to the same conclusions. They designated the prisms occurring in the Taeniolabidoidea "large and arcade-shaped", while those of the Ptilodontoidea "small and circular". They show, however, that the division of enamel microstructure, although occurring in most members of both suborders, does not apply to all genera. Fosse *et al.* (1985) documented the existence of gigantoprismatic enamel in four multituberculate teeth from Khovboor. These teeth are now described as belonging to: ***Arginbaatar dimitrievae*** (P_4 GI PST 10—11 and P_4 GI PST 10—13); *?Eobaatar minor* (GI PST 10—23) and Unidentified Upper Incisor (GI PST 10—29). Thus the gigantoprismatic enamel occurs in both the Eobaataridae and Arginbaataridae and made its appearance at least as early as ?Aptian or Albian, possibly in the common ancestors of both families. This finding would agree with the conclusion of Krause and Carlson (pers. inf.) who claim that among the forms with prismatic enamel the gigantoprismatic one is primitive. However, the problem arises at exactly which level of multituberculate evolution the gigantoprismatic enamel made its appearance. Unfortunately we do not know as yet the enamel microstructure in members of the Plagiaulacidae and in post-Kimmeridgian members of the Paulchoffatiidae.

The Arginbaataridae, although highly specialized in the structure and mode of growth of P_4 (which is unusually large, partly covered with enamel and rotates during ontogeny) retains some primitive features (see below). They also display a unique structure of the mandible, which is bent anteromedially below the anterior part of P_4. As a consequence the premolars and molars are arranged parallel with regard to the posterior part of the ramus of the mandible, but diagonal with respect to the anterior part of the ramus. Hahn (1969, 1971) demonstrated that *Paulchoffatia* differs from all other multituberculates in having the tooth row nearly parallel to the border of the mandible. In all other multituberculates the lower molars are shifted inwards and the premolars outwards, which results in a diagonal arrangement of the teeth across the mandible (fig. 6). In this respect the Arginbaataridae is in some way intermediate (only morphologically) between *Paulchoffatia* and other multituberculates.

Two infraorbital foramina occur in the Paulchoffatiidae (Hahn 1985). We documented above that they occur also in the Morrison Formation *Ctenacodon*, assigned on the basis of the structure of M_2 to the Plagiaulacidae (Hahn and Hahn 1983). It seems possible that two infraorbital foramina were characteristic also for some primitive members of the Plagiaulacidae. The canine among the Multituberculata has been found in some members of the Paulchoffatidae (Hahn 1977, Hahn and Hahn 1983); it is found now in the Arginbaataridae. The features which ally the Arginbaataridae with the Paulchoffatidae (two infraorbital foramina and the presence of a canine) are plesiomorphic, and one cannot conclude on the basis of them that the Arginbaataridae share gigantoprismatic enamel with the Eobaataridae (and all the Taeniolabidoidea). If gigantoprismatic enamel made its appearance only once in the evolution of Multituberculata, it would be parsimonious to conclude that the Eobaataridae and the Arginbaataridae may derive from a common ancestor. As the Eobaataridae derive from among the Plagiaulacidae, the common ancestor of the Eobaataridae and Arginbaataridae was probably a plagiaulacid. The Arginbaataridae is a specialized dead-end line which cannot be regarded as remaining close to the ancestors of the Taeniolabidoidea. The Eobaataridae, in contrast, are in some respects intermediate between the Jurassic Plagiaulacidae and advanced (Late Cretaceous) Taeniolabidoidea, and may be regarded as lying close to the forms that gave rise to the Late Cretaceous and Tertiary Taeniolabidoidea.

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ZOFIA KIELAN-JAWOROWSKA, DEMBERLYIN DASHZEVEG i BORIS A. TROFIMOV

WCZESNO-KREDOWE MULTITUBERKULATY Z MONGOLII I PORÓWNANIE Z FORMAMI JURAJSKIMI

Streszczenie

W pracy opisano kolekcje wczesno-kredowych multituberkulatów z Mongolii (?Apt lub Alb, miejscowość Howbur, somon Guczin Us, na pustyni Gobi), znajdujące się w zbiorach Instytutu Paleontologicznego Akademii Nauk ZSRR w Moskwie, oraz Instytutu Nauk Geologicznych Akademii Nauk Mongolskiej Republiki Ludowej w Ułan Bator. Kolekcje te obejmują łącznie 68 okazów pojedynczych zębów, bądź fragmentów szczęk z zębami. W zespole z Howbur wyróżniono cztery gatunki multituberkulatów: *Eobaatar magnus* gen. n., sp. n. i *Eobaatar minor* gen. n., sp. n. (zaliczone do nowej rodziny Eobaataridae w obrębie podrzędu Taeniolabidoidea), *Monobaatar mimicus* gen. n., sp. n. (którego przynależność rodzinowa nie została rozpoznana), oraz *Arginbaatar dimitrievae* Trofimov (zaliczony do rodziny Arginbaataridae Hahn i Hahn, w podrzędzie ?Plagiaulacoidea). Mimo że w badanym materiale górne i dolne szczęki oraz zęby nie zostały znalezione razem, w przypadku gatunków *Eobaatar magnus* i *Arginbaatar dimitrievae* zrekonstruowano, z zastrzeżeniem naturalne zestawy dolnych i górnych zębów, w oparciu o wielkość, typ ornamentacji, oraz częstość występowania, chociaż z powodu małej liczby okazów nie można było zastosować metod statystycznych. Pozostałe gatunki: *Eobaatar minor* został ustalony na dolnych zębach, zaś *Monobaatar mimicus* na górnych. Nie jest wykluczone, że *Eobaatar minor* i *Monobaatar mimicus* są konspecyficzne.

Zarówno Eobaataridae, jak i Arginbaataridae mają po pięć górnych i po trzy dolne zęby przedtrzonowe (tak jak u późno-jurajskich Plagiaulacidae), ponadto Eobaataridae mają na dolnym siekaczu emalię ograniczoną tylko do dolnej powierzchni (tak jak u Taeniolabidoidea), oraz P_4 o przednich i tylnych krawędziach równoległych, z jednym guzkiem bazalnym, (gdy u późno-jurajskich Plagiaulacidae P_4 ma równoległe krawędzie i szereg guzków bazalnych, a dolny siekacz jest kompletnie pokryty emalią). Tak więc Eobaataridae wykazują cechy przejściowe między późno-jurajskimi Plagiaulacidae oraz późno-kredowymi i trzeciorzędowymi Taeniolabidoidea. Rodzina ta została zaliczona do Taeniolabidoidea ze względu na ograniczoną emalię na dolnym siekaczu, co jest cechą synapomorficzną Taeniolabidoidea (Sloan i Van Valen 1965).

Rodzina Arginbaataridae wykazuje mieszaninę cech wysokiej specjalizacji i cech prymitywnych. Dolne siekacze są tu kompletnie pokryte emalią; występują dwa otwory podoczodołowe, oraz przypuszczalnie zachował się górny kieł. Te dwie ostatnie cechy są plezjomorficzne i zostały dotychczas stwierdzone u multituberkulatów w późnojurajskiej rodzinie Paulchoffatiidae (należącej do podrzędu Plagiaulacoidea). Z drugiej strony Arginbaataridae wykazują wysoką specjalizację w budowie P_4, który jest bardzo duży, wachlarzowatego kształtu, pozbawiony guzków bazalnych, oraz (jedyny przypadek wśród multituberkulatów) jest tylko częściowo pokryty emalią. Na podstawie serii zachowanych żuchw z zębami, oraz stopnia starcia zębów,

wykazano że P_4 podczas rozwoju ontogenetycznego przesuwał się rotacyjnie do przodu na miejsce niewielkich P_3 i P_2, które ulegały starciu i resorbcji. Tego typu rotacja zębów nie była dotychczas znana u multituberkulatów.

Zarówno u Arginbaataridae jak i u Eobaataridae występuje gigantopryzmatyczna struktura emalii (Fosse *et al.* 1985) charakterystyczna dla podrzędu Taeniolabidoidea, oraz dla rodziny Cimolomyidae o nieustalonej przynależności do podrzędu. Jeżeli gigantopryzmatyczna struktura emalii powstała w ewolucji multituberkulatów tylko raz, należy przyjąć że Arginbaataridae i Eobaataridae pochodzą od wspólnego przodka, którym byłby zapewne przedstawiciel jurajskiej rodziny Plagiaulacidae.

Dla porównania w pracy zilustrowano pewne późno-jurajskie multituberkulaty z Wielkiej Brytanii i z Ameryki Północnej.

Praca została wykonana w ramach problemu CPBP 04.03 oraz planu o współpracy naukowej między Polską Akademią Nauk i Akademią Nauk ZSRR (30.4) oraz Akademią Nauk Mongolskiej Republiki Ludowej.

EXPLANATIONS OF PLATES 1—22

Plate 1

Khovboor Beds (?Aptian or Albian), Khovboor, Guchin Us somon, Gobi Desert, Mongolia

1a. *Eobaatar magnus* sp. n., left P_4, buccal view, PIN 3101/57 holotype (see also pl. 15: 1)
1b. The same, lingual view.
2a. *Eobaatar magnus* sp. n., anterior part of left P_4, lingual view, PIN 3101/59a.
2b. The same, buccal view.
3a. *Eobaatar magnus* sp. n., right P_4 (photo of epoxy resin cast), buccal view, PIN 3101/60.
3b. The same, lingual view.
4a. *Eobaatar magnus* sp. n., strongly worn specimen, posterior part of left P_4, buccal view, PIN 3101/59b.
4b. The same, lingual view.
5. ?*Eobaatar minor* sp. n., anterior part of left P_4, buccal view, GI PST 10—23.

All SEM micrographs ×15

Plate 2

Eobaatar magnus sp. n.

Khovboor Beds (?Aptian or Albian), Khovboor, Guchin Us somon, Gobi Desert, Mongolia

1a. Fragment of right mandible with M_2, coated with ammonium chloride, occlusal view, GI PST 10—43, stereophotograph ×15.

1b. The same, lingual view, coated with ammonium chloride, stereophotograph ×15.
1c. The same, coated with ammonium chloride, buccal view, ×15.
2a. Fragment of left mandible with M_1, M_2 and alveolus for posterior root of P_4, lingual view, PIN 3101/53, SE micrograph ×15.
2b. SE micrograph of the same, occlusal view, ×15.
2c. SE micrograph of the same, buccal view, ×15.
3. Left M_1, occlusal view, PIN 3101/50e, SEM micrograph ×30.

Plate 3

Khovboor Beds (?Aptian or Albian), Khovboor, Guchin Us somon, Gobi Desert, Mongolia

1a. *Eobaatar magnus* sp. n., right P^x (possibly P^1 or P^2), occlusal and slightly buccal view, GI PST 10—34, ×15.
1b. The same, occlusal view, ×15.
1c. The same, lingual view, ×15.
1d. The same, buccal view, ×15.
2. *Eobaatar magnus* sp. n., left P^x (possibly P^3), GI PST 10—35, occlusal view, ×20.
3a. *Monobaatar mimicus* sp. n., partial maxilla with P^2—P^4 and alveoli for P^1 and P^5, buccal view, PIN 3101/65 holotype, ×5.
3b. P^2—P^4 of the same, buccal view, ×15.
3c. The same, occlusal and slightly buccal view, ×15.
3d. P^2—P^4 of the same, occlusal view, ×30.

All except 3a SEM micrographs

Plate 4

Eobaatar magnus sp. n.

Khovboor Beds (?Aptian or Albian), Khovboor, Guchin Us somon, Gobi Desert, Mongolia

1a. Right ?P^4, occlusal view, coated with ammonium chloride, GI PST 10—27, stereo-photograph, ×15.
1b. Stereo-photograph of the same, coated with ammonium chloride, lingual view, ×15.
1c. The same coated with ammonium chloride, buccal view, ×15.
1d. SEM micrograph of the same occlusal and slightly anterolateral view, ×30.
1e. SEM micrograph of the same, occlusal and slightly anteromedial view, ×30.
1f. SEM micrograph of the same, occlusal view, ×20.
2a. Right ?P^5, occlusal view, GI PST 10—16, SEM micrograph, ×20.
2b. SEM micrograph of the same in oblique anteroocclusal view, ×30.
3a. Left ?P^5, occlusal view, GI PST 10—45, ×30.
3b. The same, buccal view, coated with ammonium chloride, ×15.

Plate 5

Eobaatar magnus sp. n.

Khovboor Beds (?Aptian or Albian), Khovboor, Guchin Us somon, Gobi Desert, Mongolia

1a. Left ?P^5, occlusal and slightly anterior view, showing anterior root, GI PST 10—31, ×30.
1b. The same, occlusal view, ×30.
1c. The same, oblique lingual-occlusal view, ×20.
1d. The same, labial view, ×30.
2a. Left ?P^5, occlusal view, GI PST 10—24, ×15.
2b. The same, occlusal and slightly anterior view, ×30.
2c. The same, anterior view, ×15.
2d. The same, labial view, ×30.

All SEM micrographs

Plate 6

Khovboor Beds (?Aptian or Albian), Khovboor, Guchin Us somon, Gobi Desert, Mongolia

1a. Unidentified, left M^1 occlusal view, GI PST 10—63, ×30.
2. Unidentified left M^1, occlusal view, (conspecific with GI PST 10—63, in fig. 1) PIN 3101/55, ×30.
3a. *Eobaatar magnus* sp. n., left M^1, occlusal view, GI PST 10—33, ×15.
3b. The same, lingual view, ×30.
3c. The same, buccal view, ×30.
3d. The same, occlusal and slightly posterior view, ×30.
4a. *?Eobaatar magnus* sp. n., right M^1, occlusal view, PIN 3101/66, ×30.
4b. The same, buccal view, ×30.

All SEM micrographs

Plate 7

Khovboor Beds (?Aptian or Albian), Khovboor, Guchin Us somon, Gobi Desert, Mongolia

1a. *?Arginbaatar dimitrievae* Trofimov, left M^2, occlusal view, GI PST 10—20, SE micrograph, ×30.
1b. The same in occlusal and slightly lingual view, SEM micrograph, ×30.
2a. *?Arginbaatar dimitrievae* Trofimov right M^2, associated with left P^x (possibly P^2 or P^3), occlusal view, coated with ammonium chloride, PIN 3101/50a, ×30.
2b. SEM micrograph of P^x of the same in occlusal and somewhat slightly lingual view, ×30.
3a. *?Monobaatar mimicus* sp. n., left M^2, occlusal view, PIN 3101/61, SEM micrograph, ×30.
3b. The same in occlusal and slightly lingual view, SEM micrograph, ×30.
4a. *Eobaatar magnus* sp. n., right M^2, occlusal view, PIN 3101/62, stereophotograph, × 15.

4b. The same in buccal view, ×15.
4c. SEM micrograph of the same occlusal view, ×30.
4d. SEM micrograph of the same, occlusal and slightly buccal view, ×30.

Plate 8

1a. *?Plagiaulax becklesii* Falconer, right M_1 and M_2 strongly worn, occlusal view; Middle Purbeck, Durlston Bay locality near Purbeck, Swanage, England; BM 47733, SEM micrograph of epoxy resin cast.
1b. The same lingual view.
2. *Loxaulax valdensis* (Smith Woodward), left M_1, occlusal view; Cliff End Bone Beds (Wealden), Cliff End near Hastings, Sussex, England; BM 10480 holotype, SEM micrograph of epoxy resin cast.
3a. *Eobaatar minor* sp. n., fragment of right mandible with alveolus for incisor, P_2, roots and crown fragment of P_3, anterior part of P_4, lingual view; Khovboor Beds (?Aptian or Albian) Khovboor, Guchin us somon, Gobi Desert, Mongolia; PIN 3101/70 holotype, SEM micrograph.
3b. SEM micrograph of the same, buccal view.
4. *Eobaatar* sp. *b*., fragment of right lower incisor, buccal view, same horizon and locality, PIN 3101/67, SEM micrograph.
5a. *Eobaatar* sp. *a*, fragment of right lower incisor, buccal view, same horizon and locality, GI PST 10—25, stereophotograph, coated with ammonium chloride.
5b. The same, lingual view, coated with ammonium chloride.

All ×15

Plate 9

1. *?Arginbaatar dimitrievae* Trofimov, left ?P^5, occlusal view, GI PST 10—44a, SEM micrograph, ×30.
2a. *Monobaatar mimicus* sp. n., left ?P^4, occlusal view, GI PST 10—26, SEM micrograph, ×30.
2b. Stereophotograph of the same, lingual view, coated with ammonium chloride, ×15.
2c. SEM micrograph of the same, buccal view, ×30.
3a. *Monobaatar mimicus* sp. n., partial left maxilla with P^1 and P^2 labial view, PIN 3101/74, ×15.
3b. The same in occlusal view, ×15.
4. Unidentified left upper incisor, lingual view, GI PST 10—29, SEM micrograph, ×33.

Plate 10

Middle Purbeck, Durleston Bay locality near Purbeck Swanage, England

1a. *Plagiaulax becklesii* Falconer, epoxy resin cast of the part of the holotype specimen, showing part of the right mandible, lower incisor and P_2—P_4, buccal view, BM 47731, coated with ammonium chloride, ×5.

1b. SEM micrograph of P_2—P_4 of the same, buccal view, ×15.
2a. *Plioprion? falconeri* (Owen), epoxy resin cast of the part of the holotype specimen, showing part of the right mandible with incisor and P_2—P_4, buccal view, BM 47730, coated with ammonium chloride, ×5.
2b. SEM micrograph of P_2—P_4 of the same, buccal view, ×15.
3. *Plioprion? minor* (Falconer), SEM micrograph of epoxy resin cast of right P_1—P_4, buccal view, BM 47729, ×15.

Plate 11

Morrison Formation (Uppermost Jurassic) Como Bluff, Wyoming, USA

1. *Ctenacodon scidens* Simpson, left mandible with P_3—M_2, lingual view, YPM 10366, ×15.
2. *Ctenacodon serratus* Marsh, left lower P_1—P_4, buccal view, YPM 13668, ×15.
3. *Ctenacodon serratus* Marsh, left mandible with P_1—M_2, buccal view, YPM 11832, ×15.
4. *Ctenacodon laticeps* (Marsh), partial left maxilla with P^1—M^2 (or C, P^2—M^2), buccal view. The arrow dentotes the groove leading to the anterior infraorbital foramen (broken), YPM 11761, ×16.5. (see also pl. 17: 3).
5. cf. *Psalodon fortis* (Marsh), left P^1—P^2, or P^2—P^3, buccal view, YPM 13678.
6. *Psalodon potens* (Marsh), left P^x (P^1, P^2 or P^3) occlusal view, YPM 13677.

All photographs of epoxy resin casts, coated with ammonium chloride.

Plate 12

Middle Purbeck, Durleston Bay locality near Purbeck Swanage, England

1. *Bolodon osborni* Simpson, fragment of right maxilla with P^1, alveolus for P^2, P^3—M^1, occlusal view, holotype BM 47735A.
2a. *Bolodon? elongatus* Simpson, fragment of maxilla with right P^1—P^3, occlusal and slightly anterior view, holotype BM 47736.
2b. The same, occlusal view.
2c. The same, lingual view.
2d. Left P^1—P^2 of the same specimen, oblique occlusal-buccal view.
3a. *Bolodon crassidens* Owen, fragment of maxilla with P^1—P^4, buccal view, I^3 preserved in this specimen is not figured, holotype BM 47735.
3b. The same, occlusal view.

All SEM micrographs of epoxy resin casts, ×15

Plate 13

Arginbaatar dimitrievae Trofimov

Khovboor Beds (?Aptian or Albian), Khovboor, Guchin Us somon, Gobi Desert, Mongolia

1a. Stereo-photograph of incomplete right mandible with P_2—M_1 alveolus for M_2; on the photograph on the right side an incomplete possibly left incisor, surrounded in posterior part by the bone, has been glued to the mandible too far anteriorly. Buccal view, holotype PIN 3101/49.

1b. Lingual view the same with ?left incisor glued as in fig. 1a in the wrong place. Both coated with ammonium chloride, ×10.
(See also plate 14: 1)

Plate 14

Arginbaatar dimitrievae Trofimov

Khovboor Beds (?Aptian or Albian), Khovboor, Guchin Us somon, Gobi Desert, Mongolia

1a. P_2—M_1 of the holotype specimen, coated with ammonium chloride, lingual view, PIN 3101/49 (see also plate 13), ×15.
1b. SEM micrograph of the same, buccal view, ×15.
1c. SEM micrograph of the same, occlusal view, ×15.
2a. Fragment of right mandible with P_2, P_3 and part of P_4, coated with ammonium chloride, buccal view, GI PST 10—11, × 10.
2b. SEM micrograph of part of the same, ×33.

Plate 15

Arginbaatar dimitrievae Trofimov

Khovboor Beds (?Aptian or Albian), Khovboor, Guchin Us somon, Gobi Desert, Mongolia

1a. Fragment of left mandible with strongly worn and reduced P_2, worn and reduced P_3, and P_4 rotated anteroventrally over the worn P_3 and P_2, buccal view, GI PST 10—12, coated with ammonium chloride, stereo photograph, ×10.
1b. Stereophotograph of the same, occlusal view, coated with ammonium chloride, ×10.
1c. The same, lingual view, coated with ammonium chloride, × 10.
2a. Fragment of left mandible with completely worn P_2, strongly worn P_3, P_4 turned over P_3, buccal view, PIN 3101/56, SEM micrograph, ×15.
2b. Lingual view of the same showing alveolus for incisor, coated with ammonium chloride, ×15.

Plate 16

Khovboor Beds (?Aptian or Albian), Khovboor, Guchin Us somon, Gobi Desert, Mongolia

1. *Eobaatar magnus* sp. n., left P_4, occlusal view, holotype PIN 3101/57, SEM stereo-micrograph, ×15; (see also pl. 1: 1).
2a. *Arginbaatar dimitrievae* Trofimov, fragment of right mandible with P_2—P_4,

anterior serrations on P_4 strongly worn; P_4 overhangs P_3 and P_2; occlusal view, PIN 3101/51, SEM stereomicrograph, ×15.

2b. Buccal view of the same coated with ammonium chloride, ×15.
2c. Lingual and slightly oblique view of the same, SEM micrograph, ×15.
3a. ***Arginbaatar dimitrievae*** Trofimov, posterior part of strongly worn P_4, buccal view, coated with ammonium chloride, PIN 3101/73a, ×15.
3b. The same, lingual view, coated with ammonium chloride, ×15.

Plate 17

Arginbaatar dimitrievae Trofimov

Khovboor Beds (?Aptian or Albian), Khovboor, Guchin Us somon, Gobi Desert, Mongolia

1a. Left P_4 with fragment of mandible, buccal view, coated with ammonium chloride, PIN 3101/73b, ×15.
1b. Lingual view of the same, coated with ammonium chloride, ×15.
2a. Fragment of right mandible with alveolus for P_2, slightly worn P_3, P_4 with worn anterior serrations, buccal view, GI PST 10—40, SE micrograph, ×15.
2b. Lingual view of the same, coated with ammonium chloride, ×15.

Ctenacodon laticeps (Marsh)

Morrison Formation (Upper Jurassic) Como Bluff, Wyoming, USA

3. Partial left maxilla with P^1—M^2 (or C, P^2—M^2), epoxy resin cast coated with ammonium chloride, occlusal view, YPM 11761, ×16,5 (see also pl. 5: 4).

Plate 18

Arginbaatar dimitrievae Trofimov

Khovboor Beds (?Aptian or Albian), Khovboor, Guchin Us somon, Gobi Desert, Mongolia

1. Right P_4 with damaged anterior serrations, buccal view, PIN 3101/71a
2. Right P_4, strongly worn, with fragment of the mandible, buccal view, GI PST 10—41 (see also pl. 19: 3).
3. Right P_4, buccal view, PIN 3101/71b.
4. Fragment of right mandible with broken incisor and posterior part of P_4, buccal view, PIN 3101/52, SEM micrograph.
5. Left P_4 with fragment of mandible, buccal view, GI PST 10—60.
6. Left P_4, buccal view, PIN 3101/71c.

All ×15

Plate 19

Arginbaatar dimitrievae Trofimov

Khovboor Beds (?Aptian or Albian), Khovboor, Guchin Us somon, Gobi Desert, Mongolia

1. Right P_4, buccal view, coated with ammonium chloride, stereophotograph, GI PST 10—13, ×10.
2. Incomplete left P_4, anterior view, coated with ammonium chloride, stereophotograph, GI PST 10—12, ×15.

3a. Right P_4, lingual view, GI PST 10—41, stereophotograph, ×10.
3b. Stereophotograph of the same, buccal view, ×10.

Plate 20

Arginbaatar dimitrievae Trofimov

Khovboor Beds (?Aptian or Albian), Khovboor, Guchin Us somon, Gobi Desert, Mongolia

1. Right M_1, occlusal view, GI PST 10—42, SE micrograph, ×30.

2a. Right M_1, oblique occlusal-buccal view, PIN 3101/50c, SE micrograph, ×30.
2b. SEM micrograph of the same, occlusal view, ×30.
3a. Right M_1, occlusal view, GI PST 10—44b, ×15.
3b. Buccal view of the same, ×15.
4. Left M_1, occlusal view, PIN 3101/50d, SEM micrograph, ×30.
5a. Fragmentary mandible with alveolus for incisor, almost completely worn P_3, very strongly worn anterior part of P_4 turned over P_3, lingual view, PIN 3101/58, SEM micrograph, ×15.
5b. SEM micrograph of the same, buccal view, ×15.

Plate 21

Arginbaatar dimitrievae Trofimov

Khovboor Beds (?Aptian or Albian), Khovboor, Guchin Us somon, Gobi Desert, Mongolia

1a. Fragmentary right maxilla with P^1—P^4, and ?alveolus for C; oblique occlusal-buccal view, PIN 3101/68, ×15.
1b. Buccal view of the same, ×15.
2a. Fragment of right maxilla with part of zygomatic arch and P^5, oblique occlusal-buccal view, GI PST 10—15, ×15.
2b. Occlusal view of the same, coated with ammonium chloride, × 15.
2c. P^5 of the same in oblique occlusal-anterior view, ×30.
3a. Right ?P^5, occlusal view, GI PST 10—36, stereophotograph, ×30.

3b. The same in buccal view, ×30.
3c. The same in lingual view, ×30.

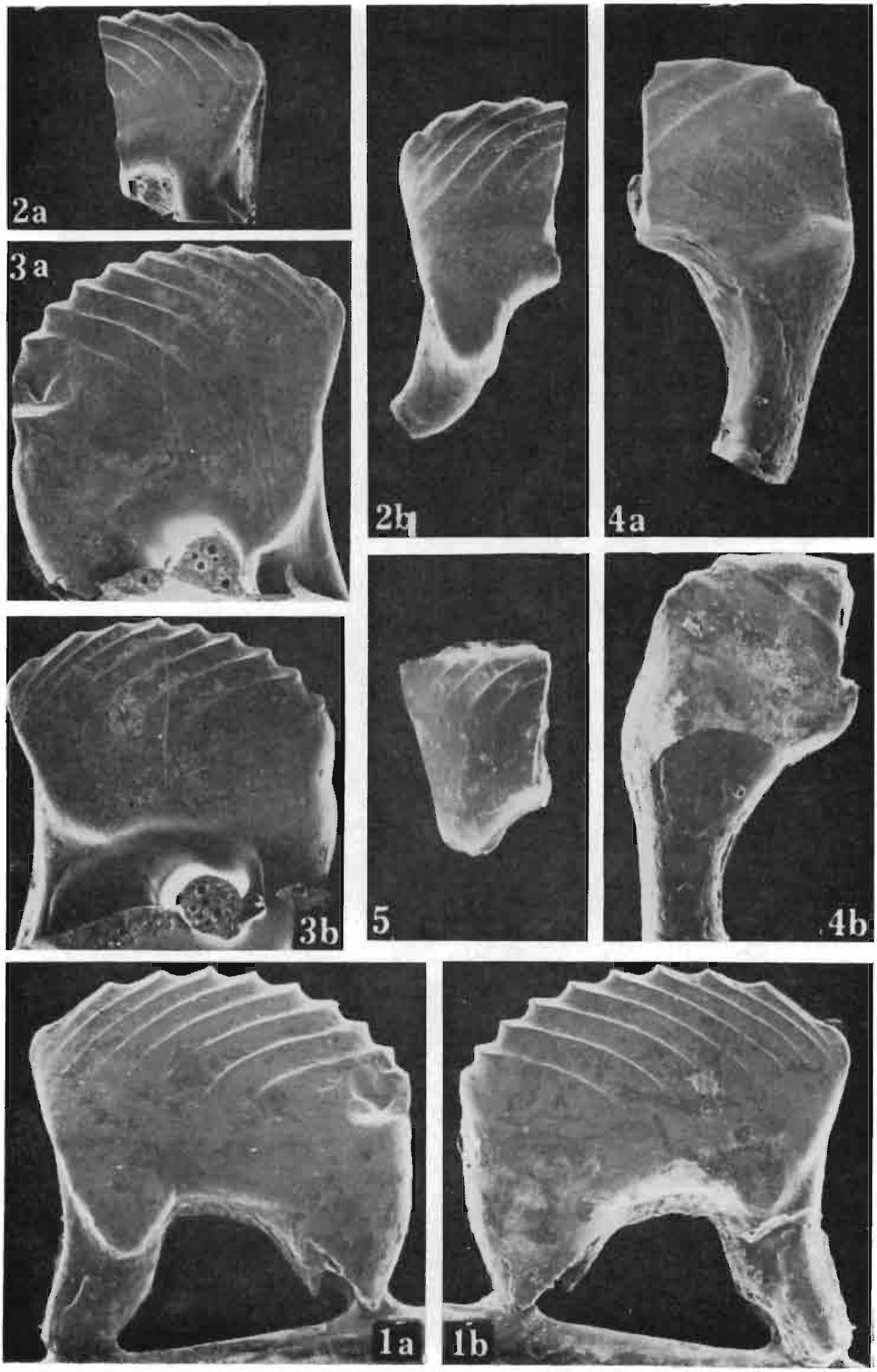
All except 2b SEM micrographs

Plate 22

Arginbaatar dimitrievae Trofimov

Khovboor Beds (?Aptian or Albian), Khovboor, Guchin Us somon, Gobi Desert, Mongolia

1a. Left maxilla with P^1—P^3, buccal view, SE micrograph of epoxy resin cast, PIN 3101/54, ×15.
1b. SEM micrograph of the same, occlusal view, ×15.
1c. SEM micrograph of the teeth of the same, occlusal view, ×30.
2. Left P^1, occlusal view, PIN 3101/50b, SE micrograph ×30.
3a. Fragment of right maxilla with P^2 and P^3, occlusal view, PIN 3101/69, coated with ammonium chloride, ×15.
3b. The same in buccal view, ×15, coated with ammonium chloride.
4a. Fragment with left maxilla with P^2 and P^3, oblique occlusal-buccal view, PIN 3101/72, coated with ammonium chloride, ×15.
4b. Buccal view of the same, coated with ammonium chloride, × 15.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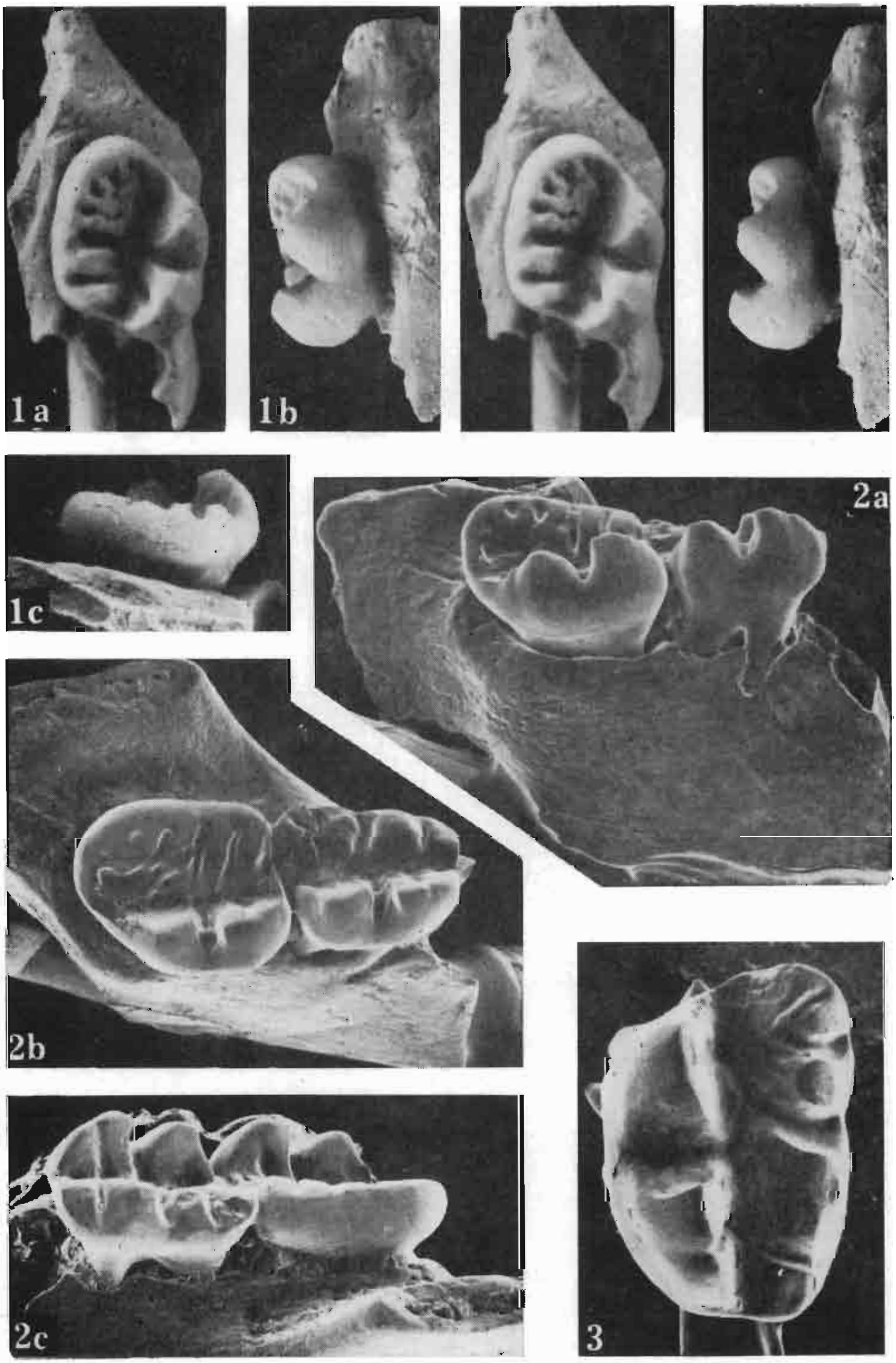
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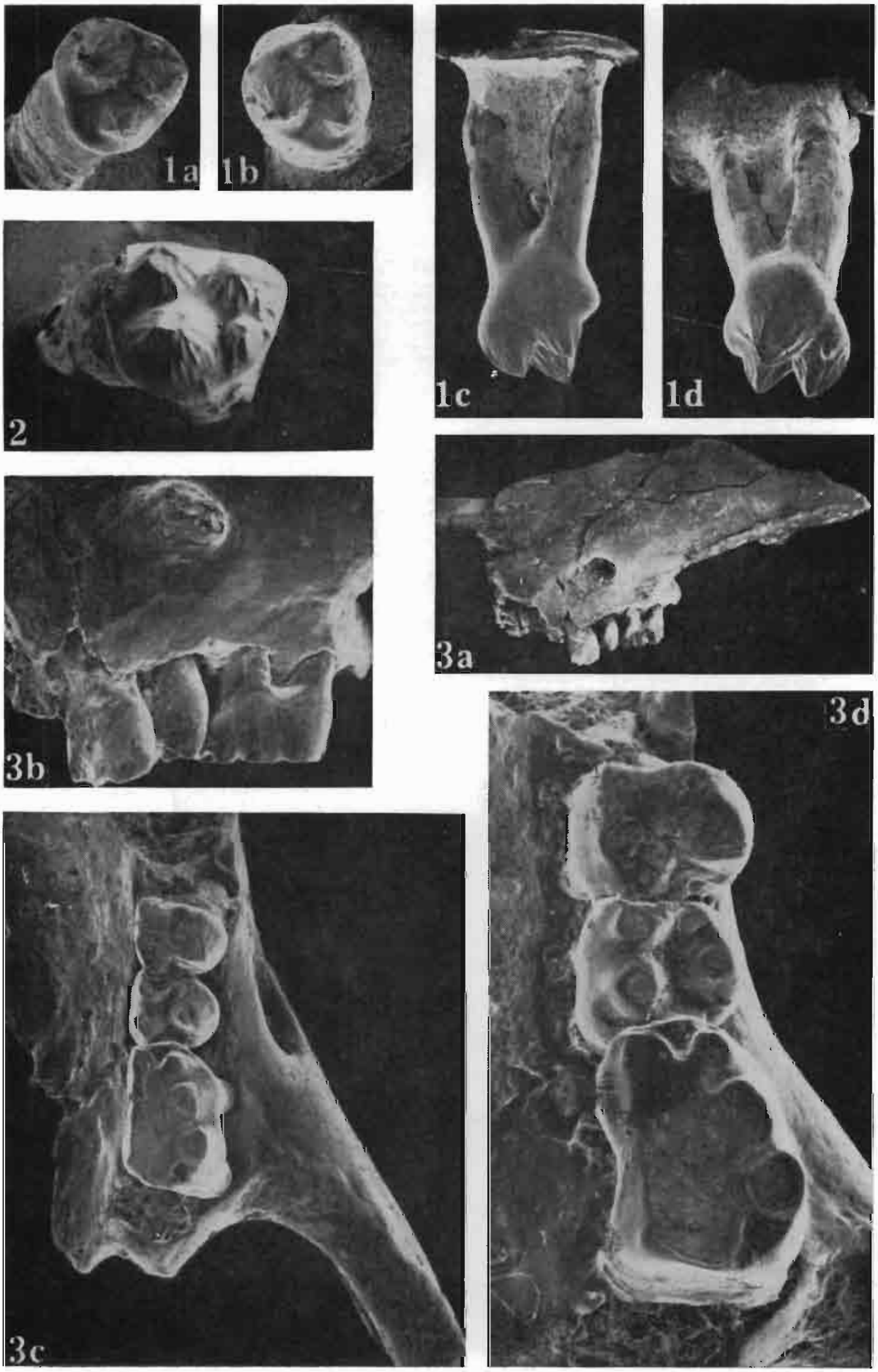
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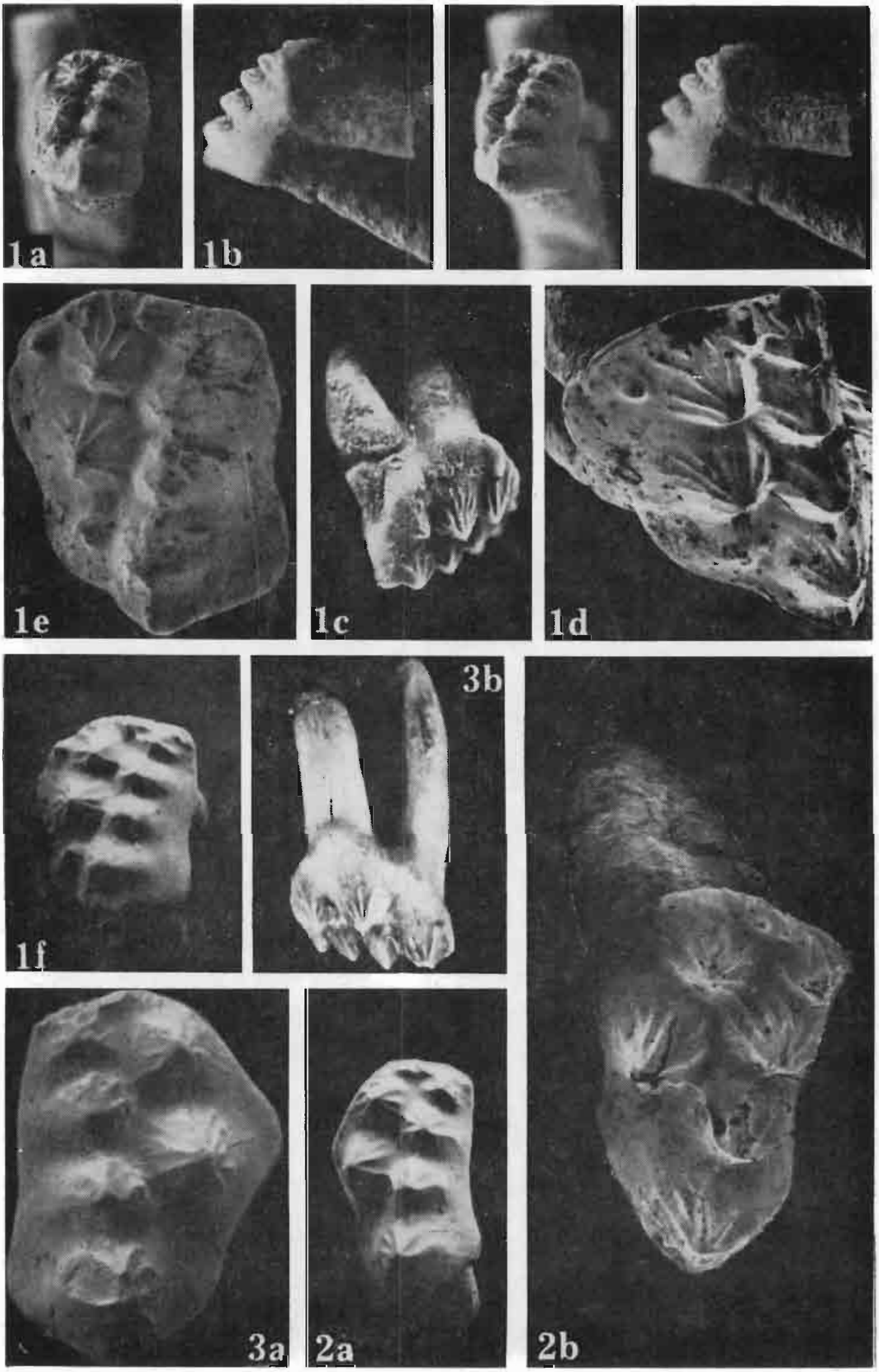
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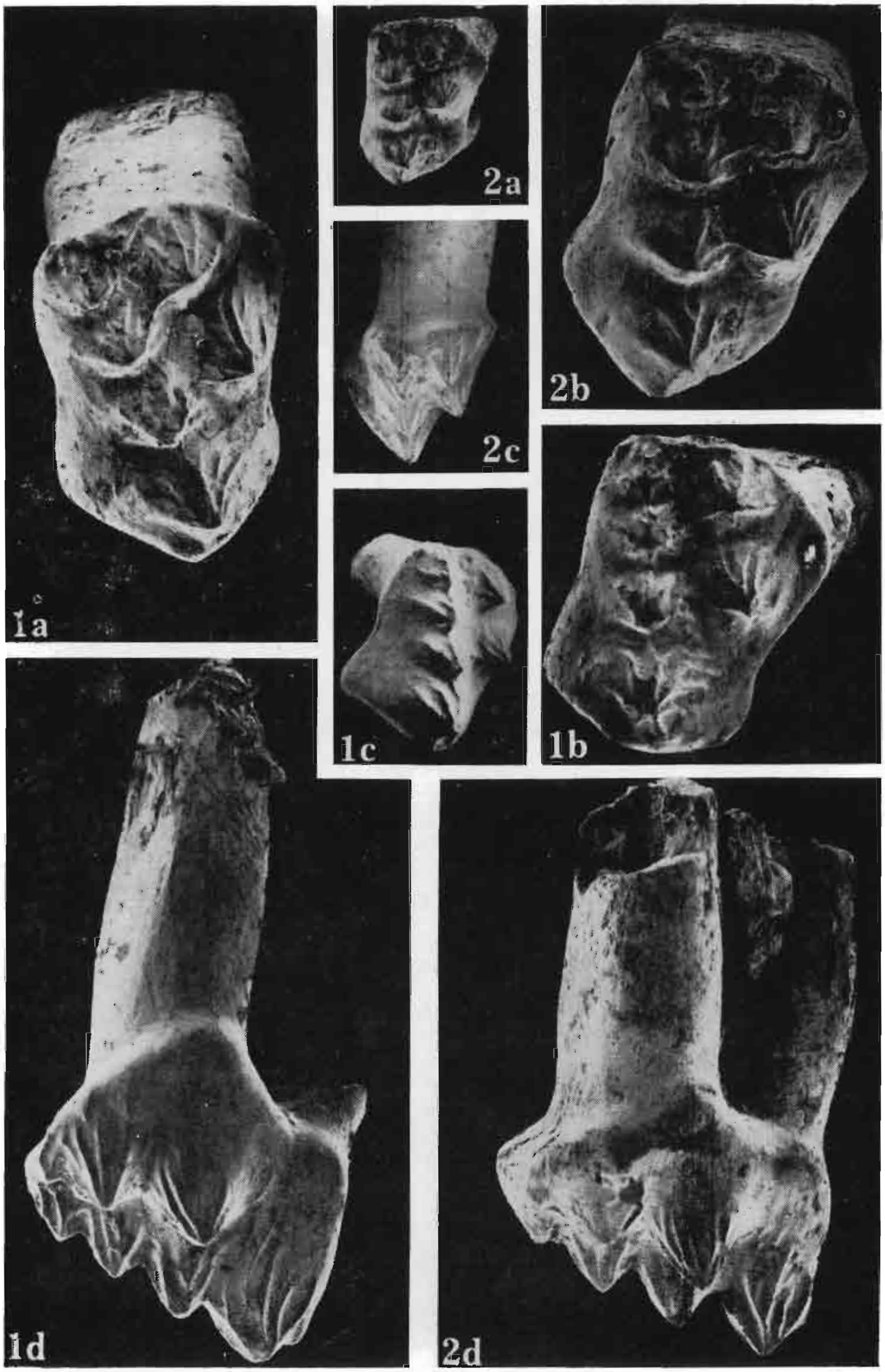
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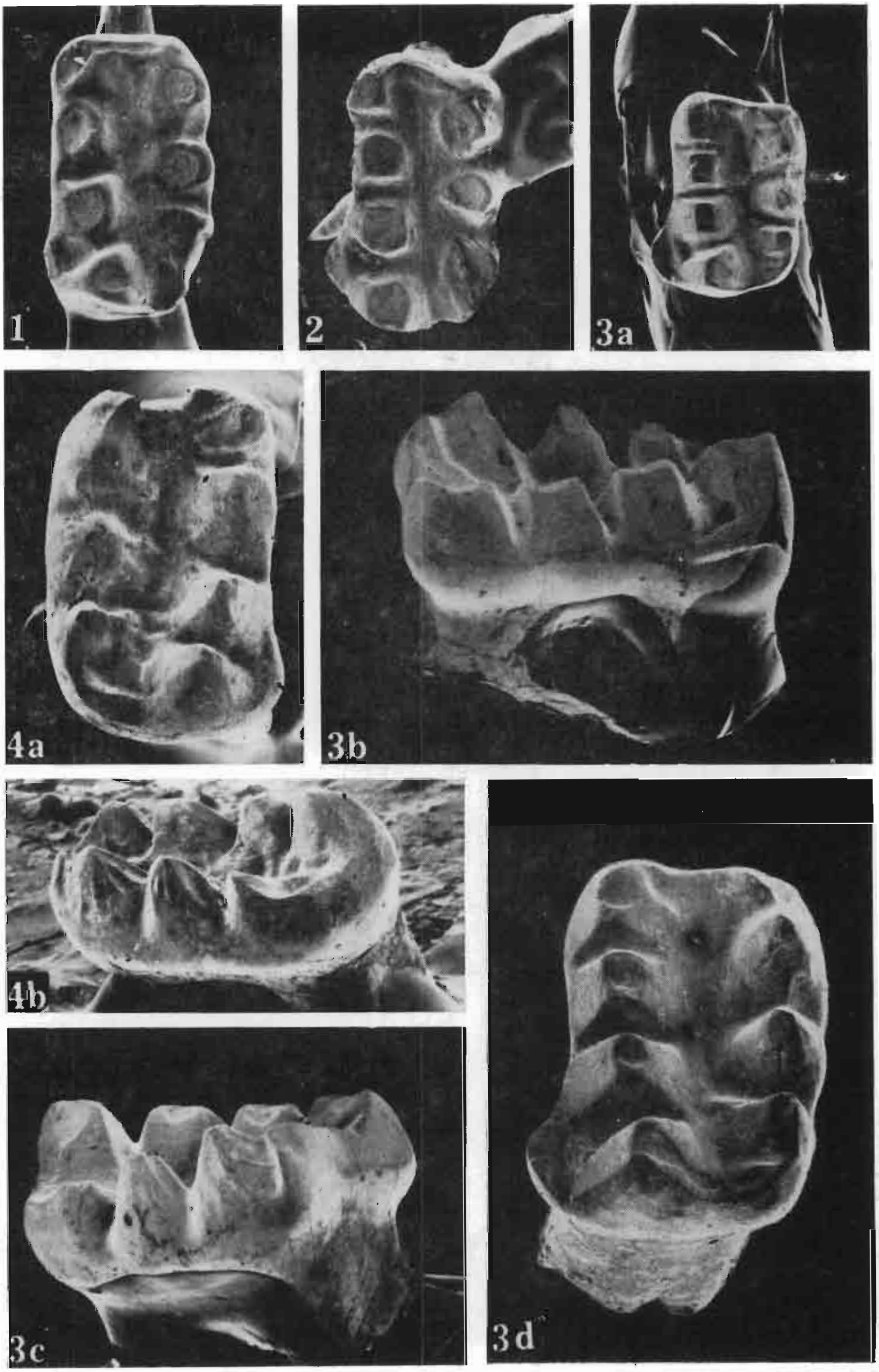
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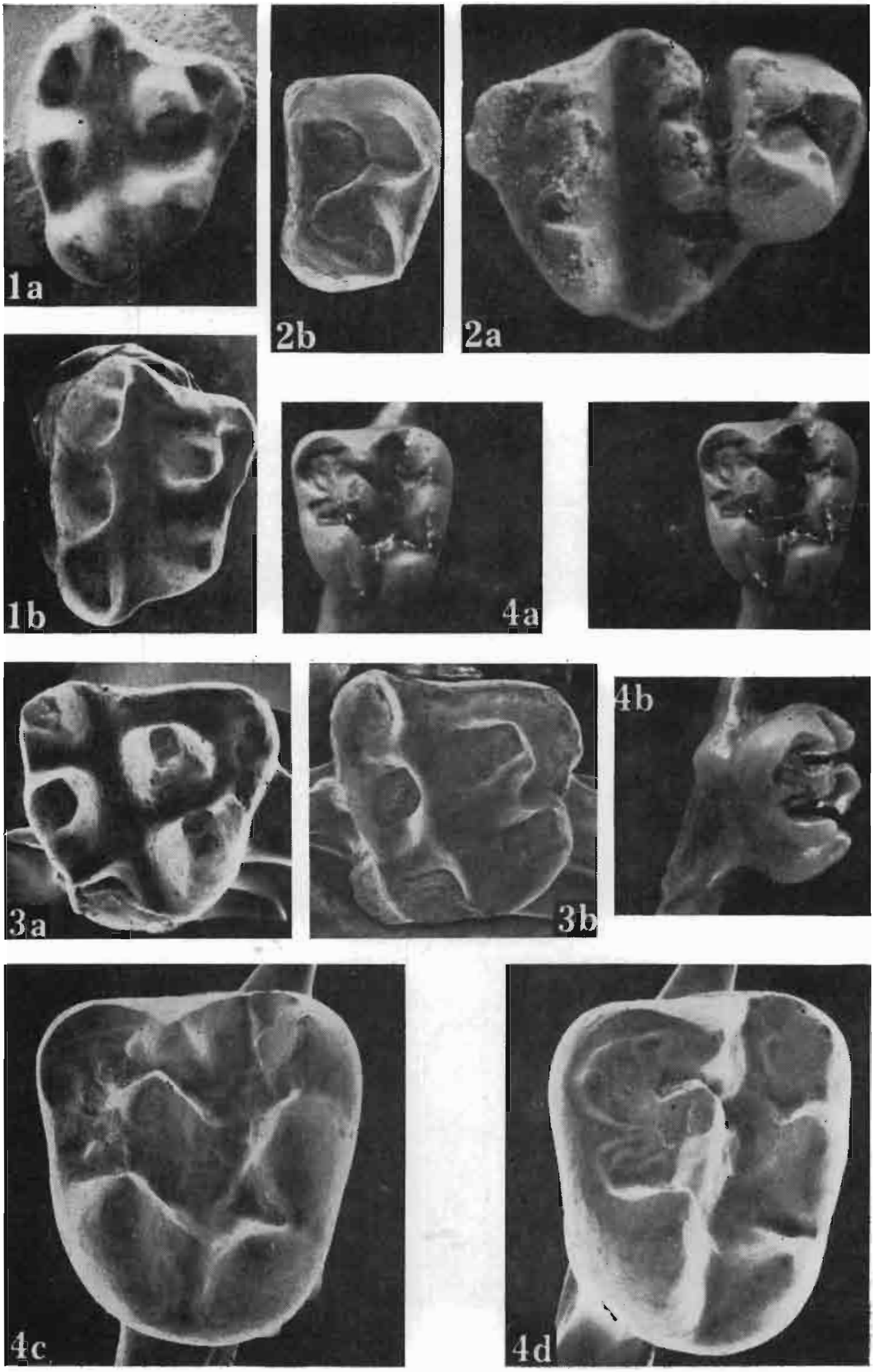
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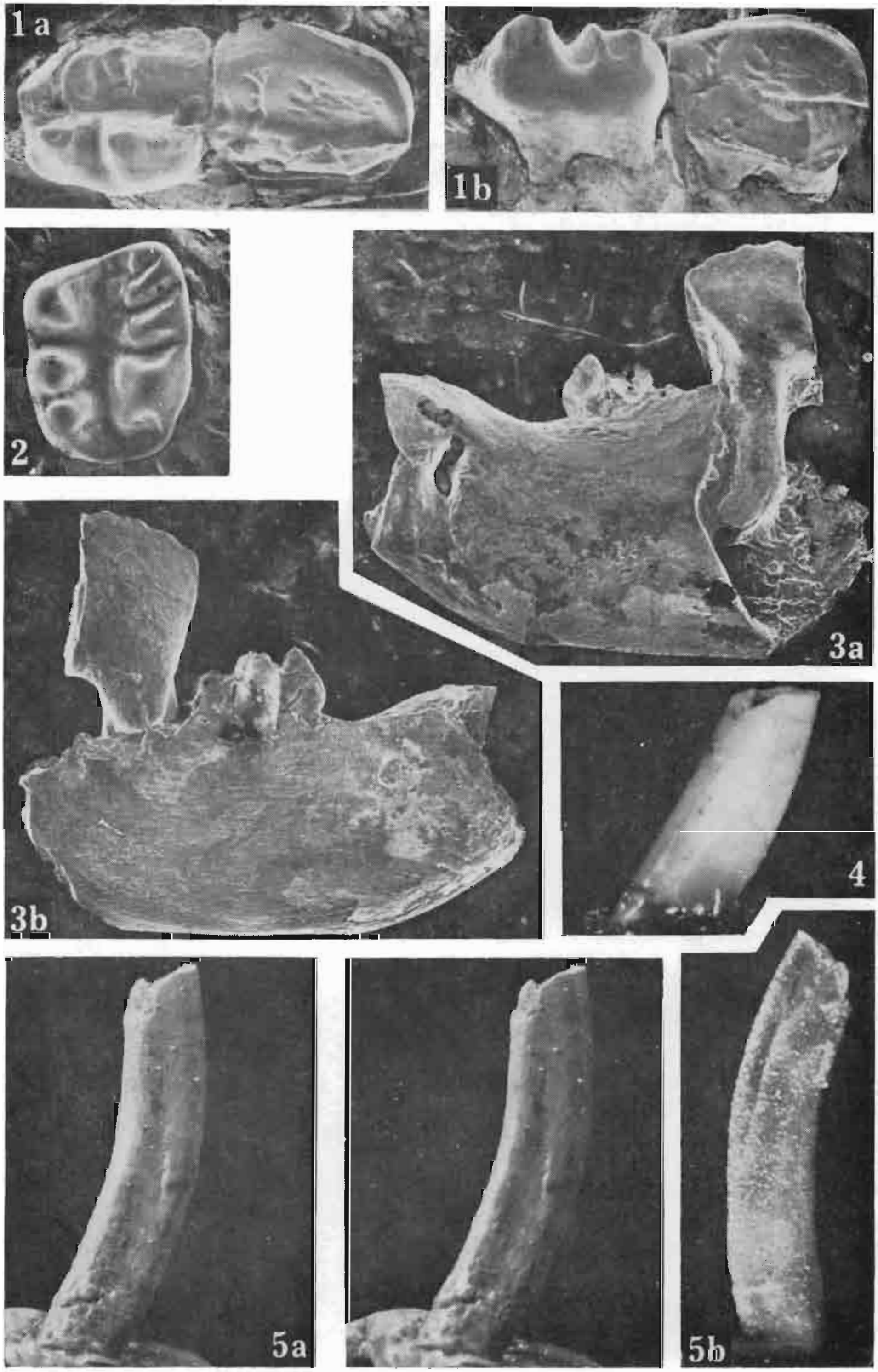
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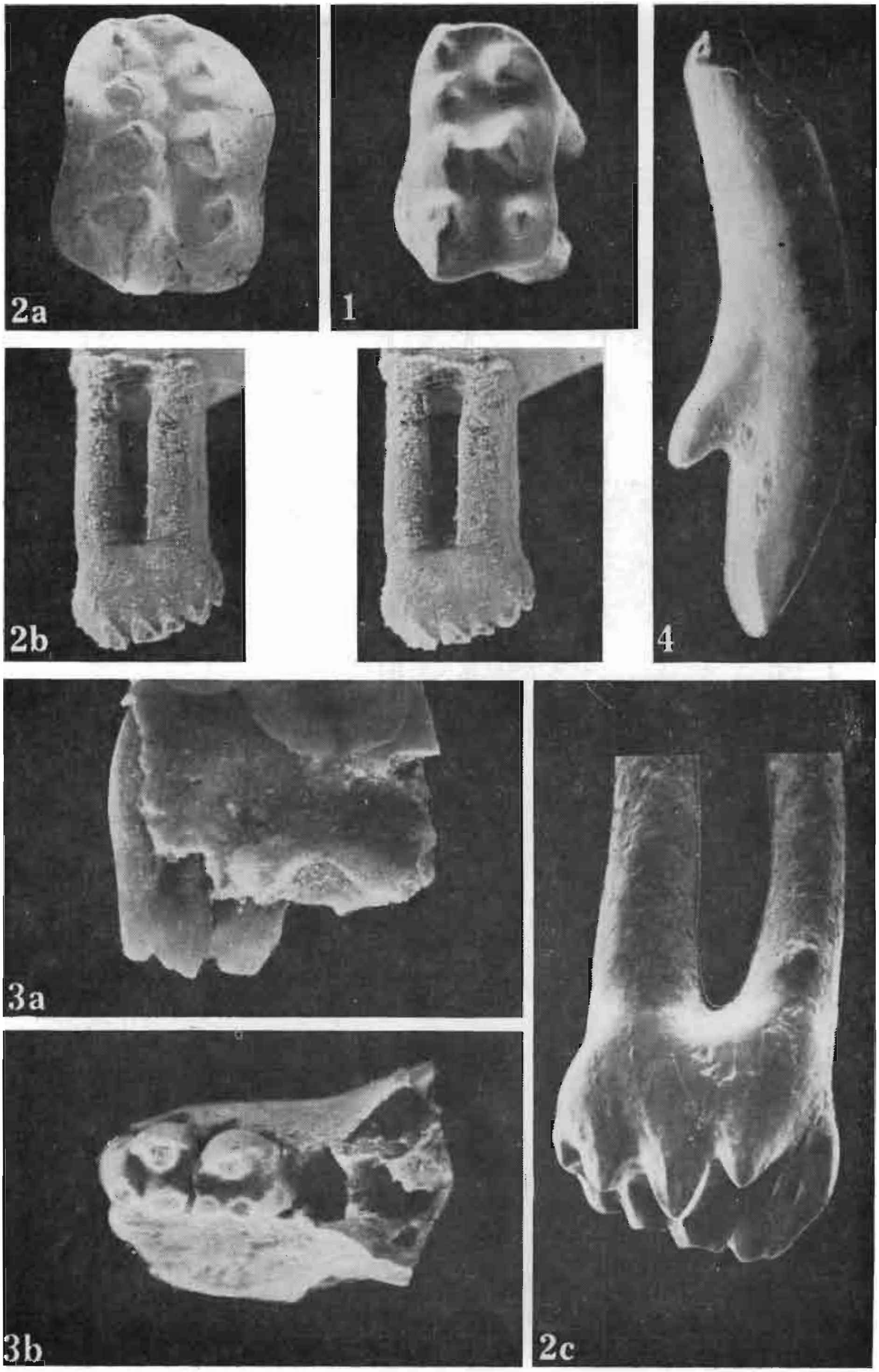
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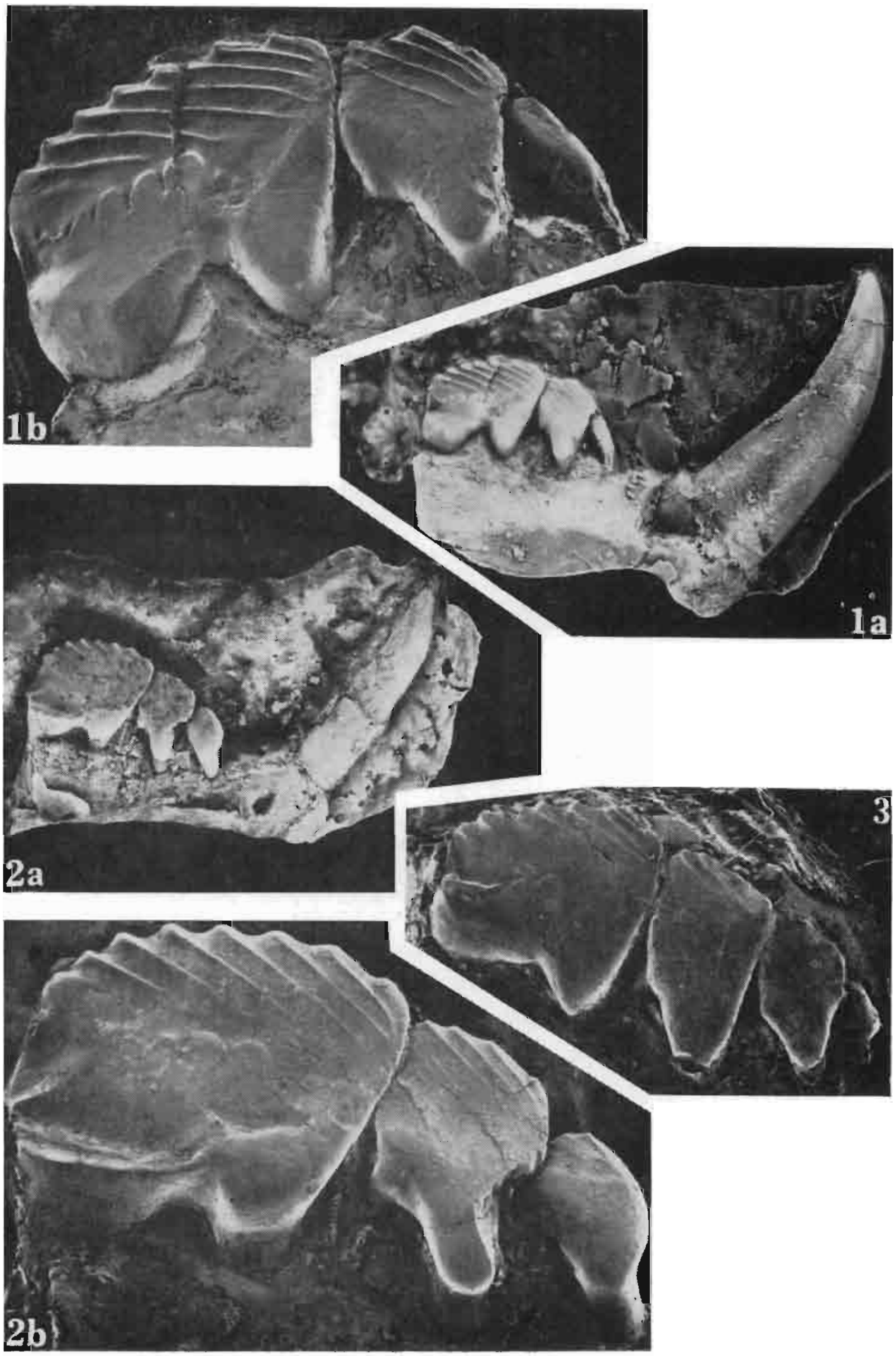
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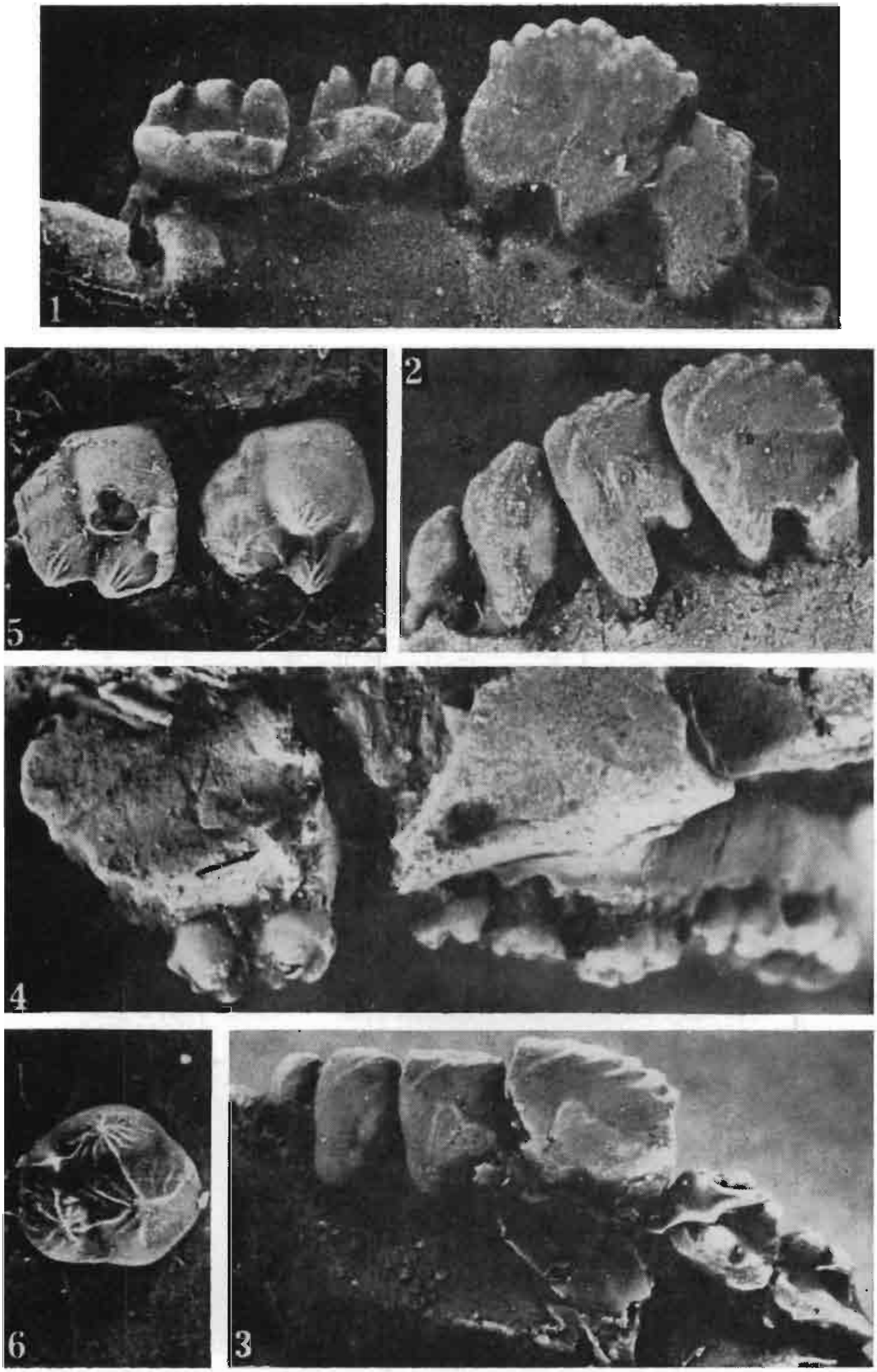
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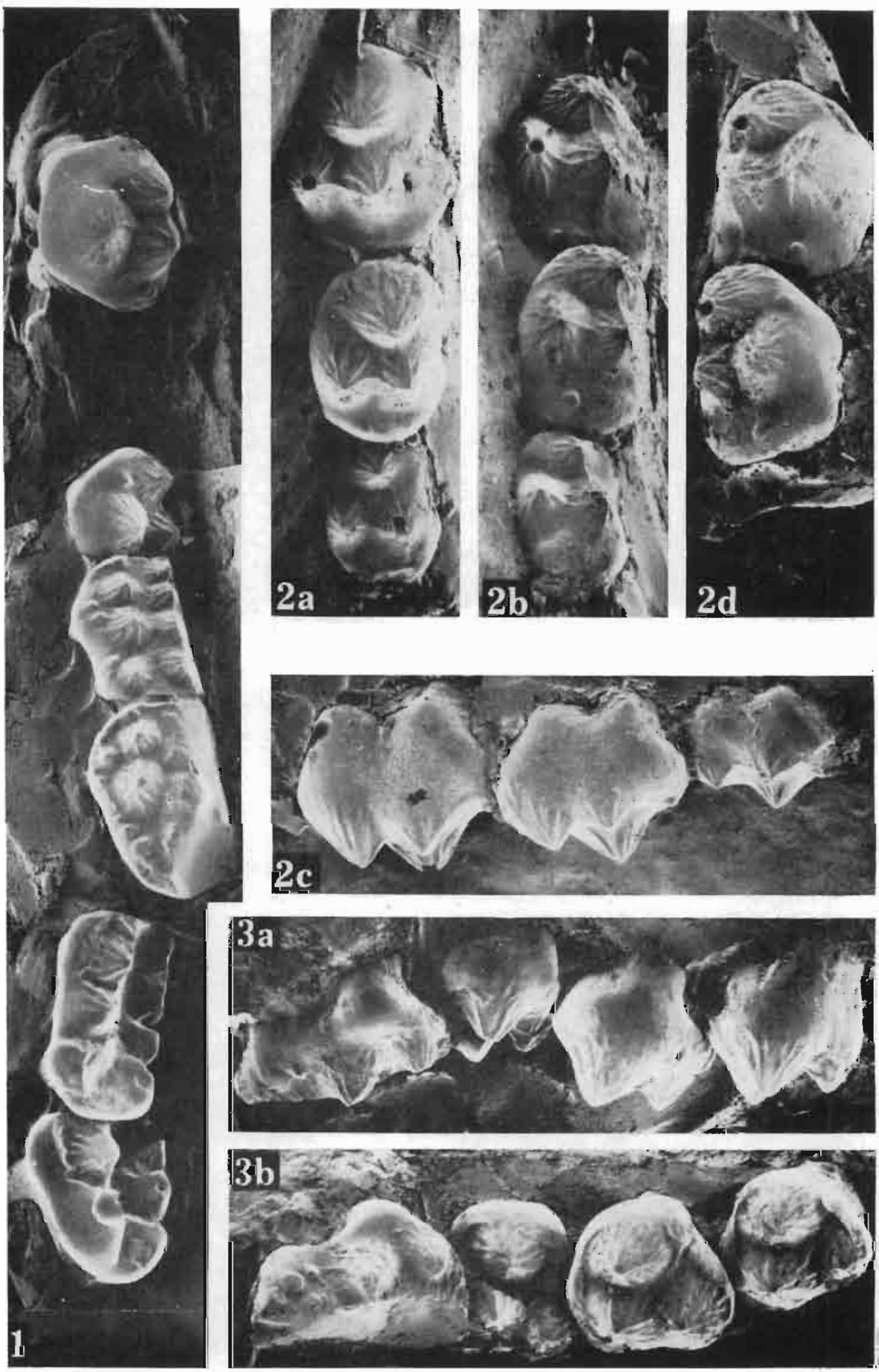
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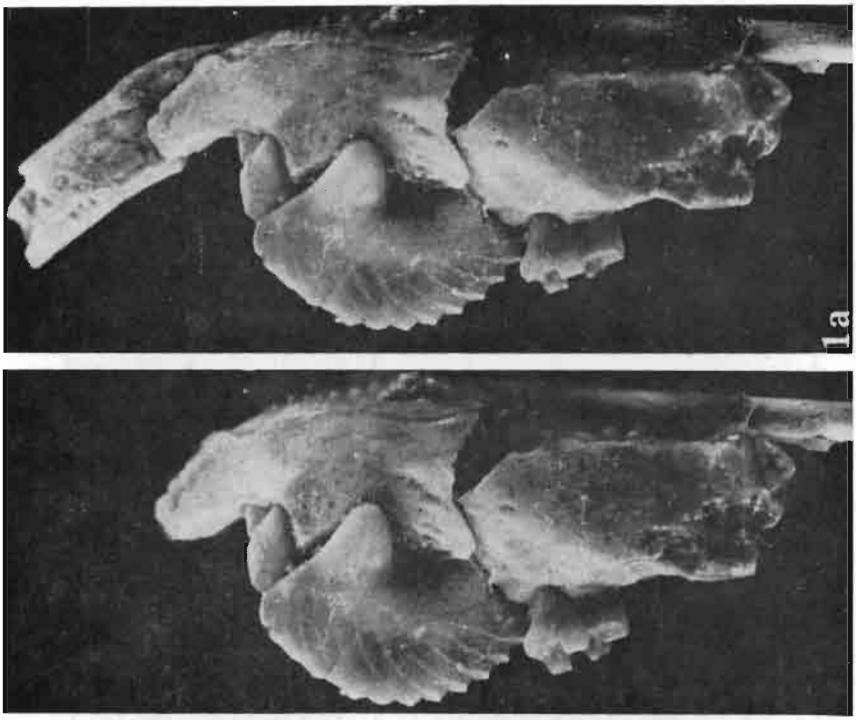
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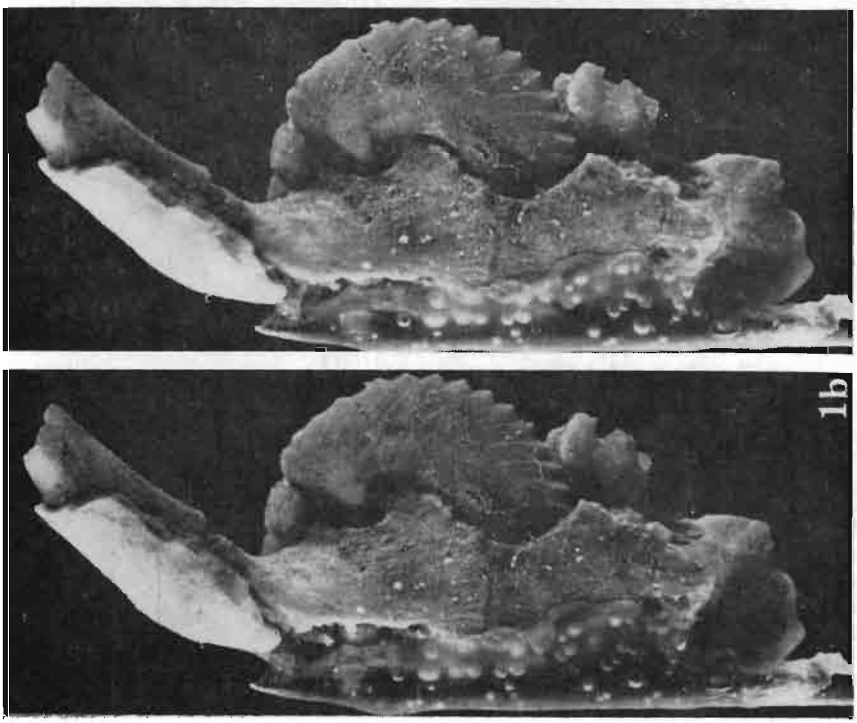
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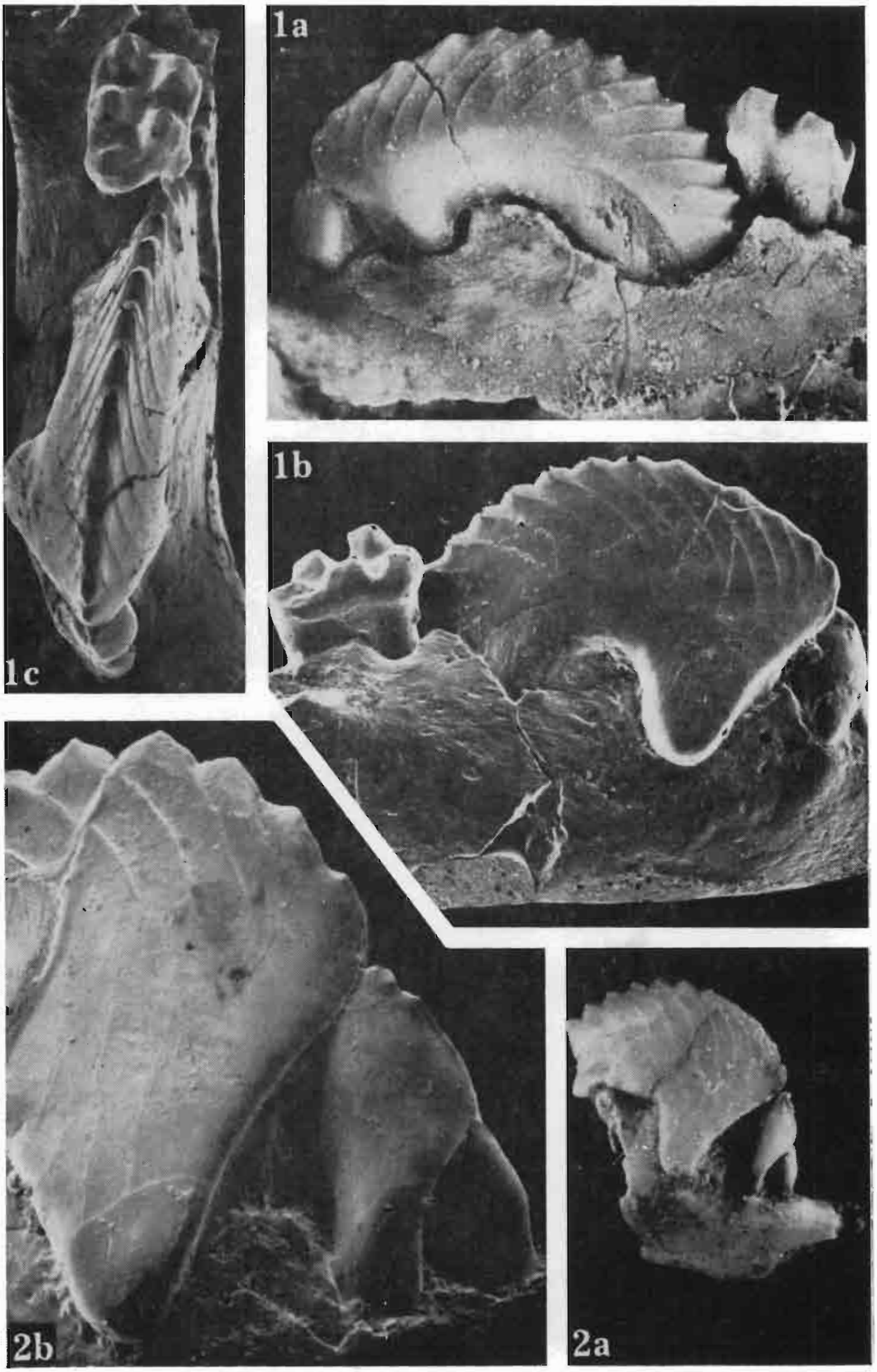
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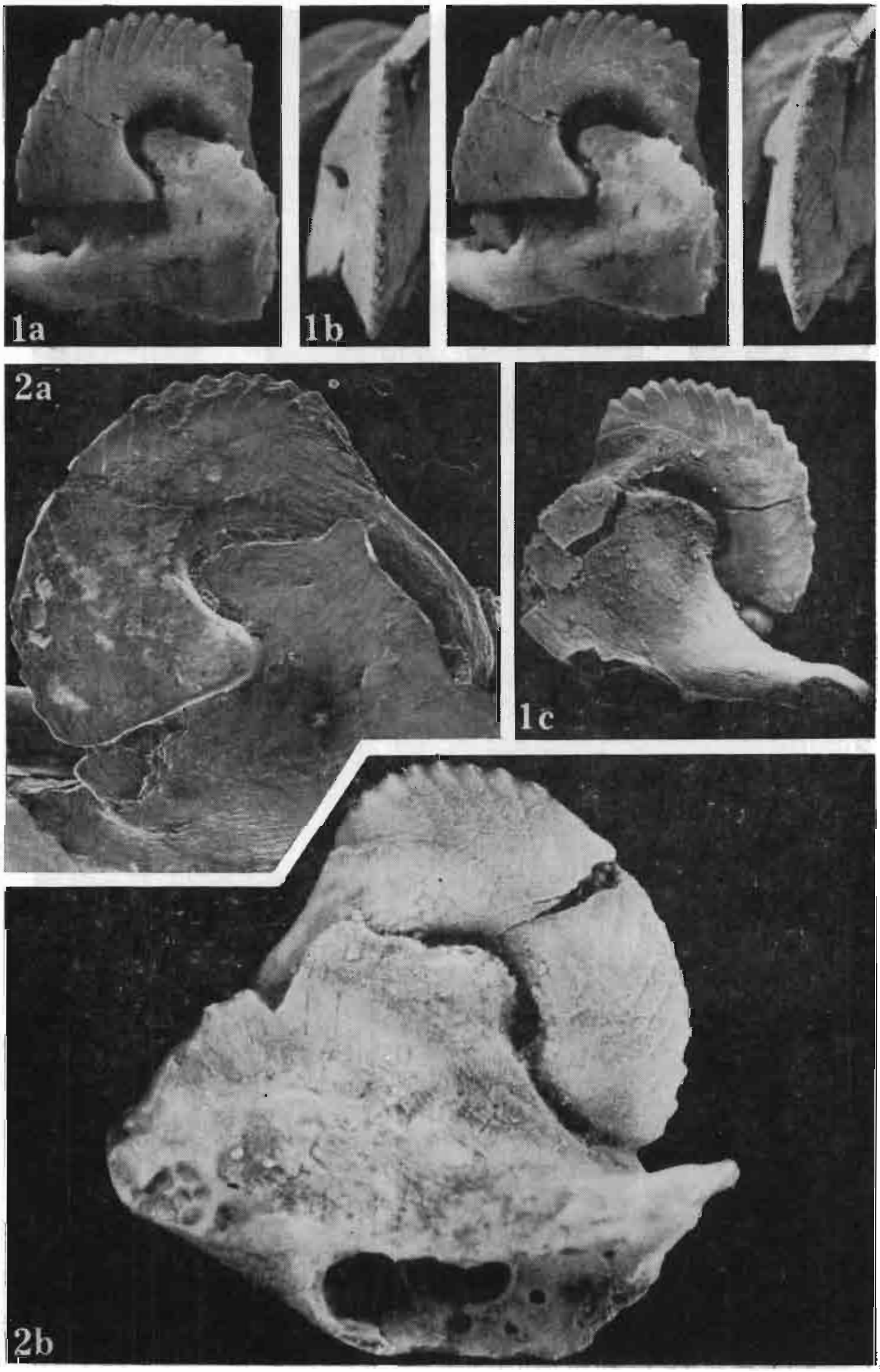
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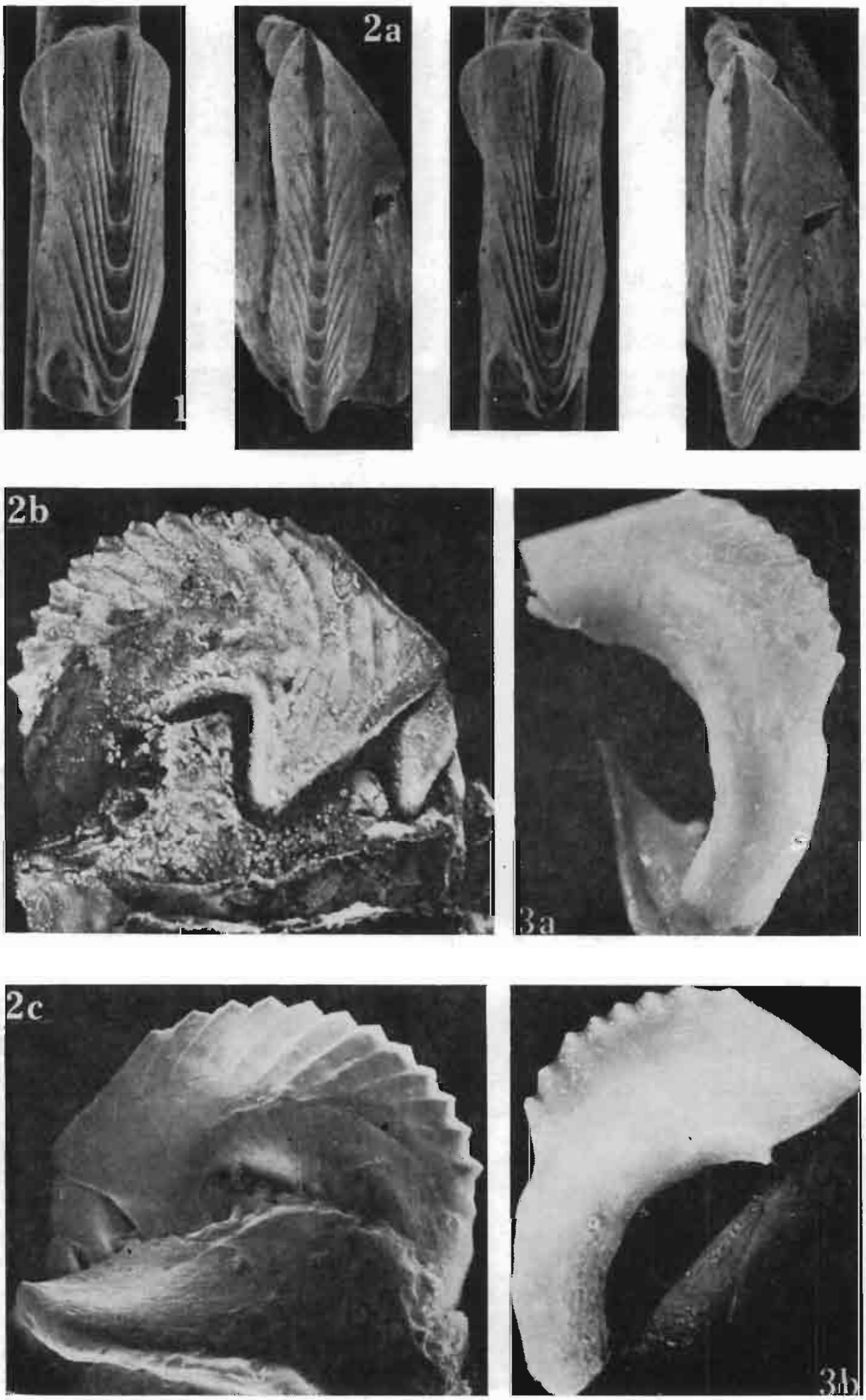
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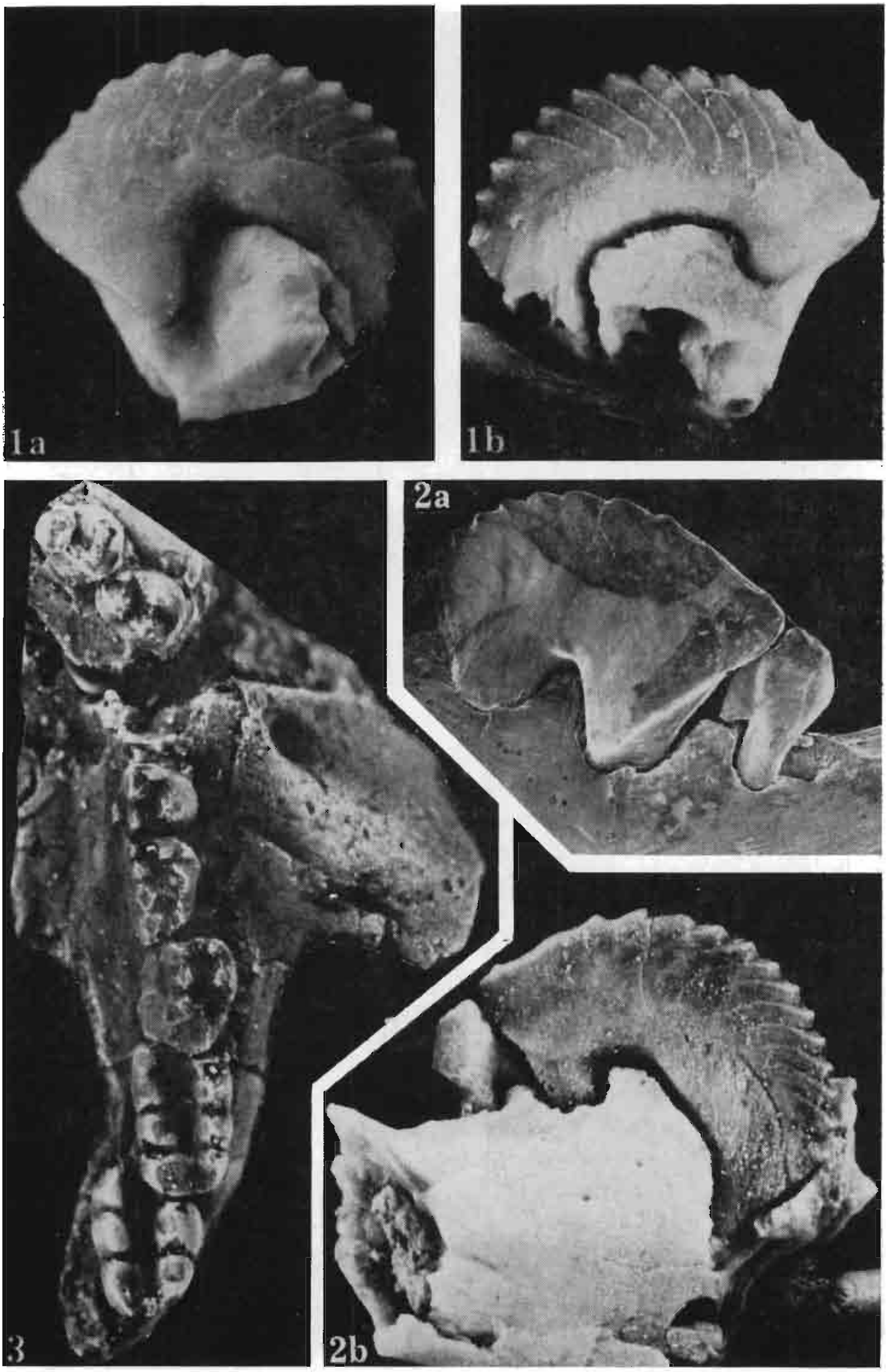
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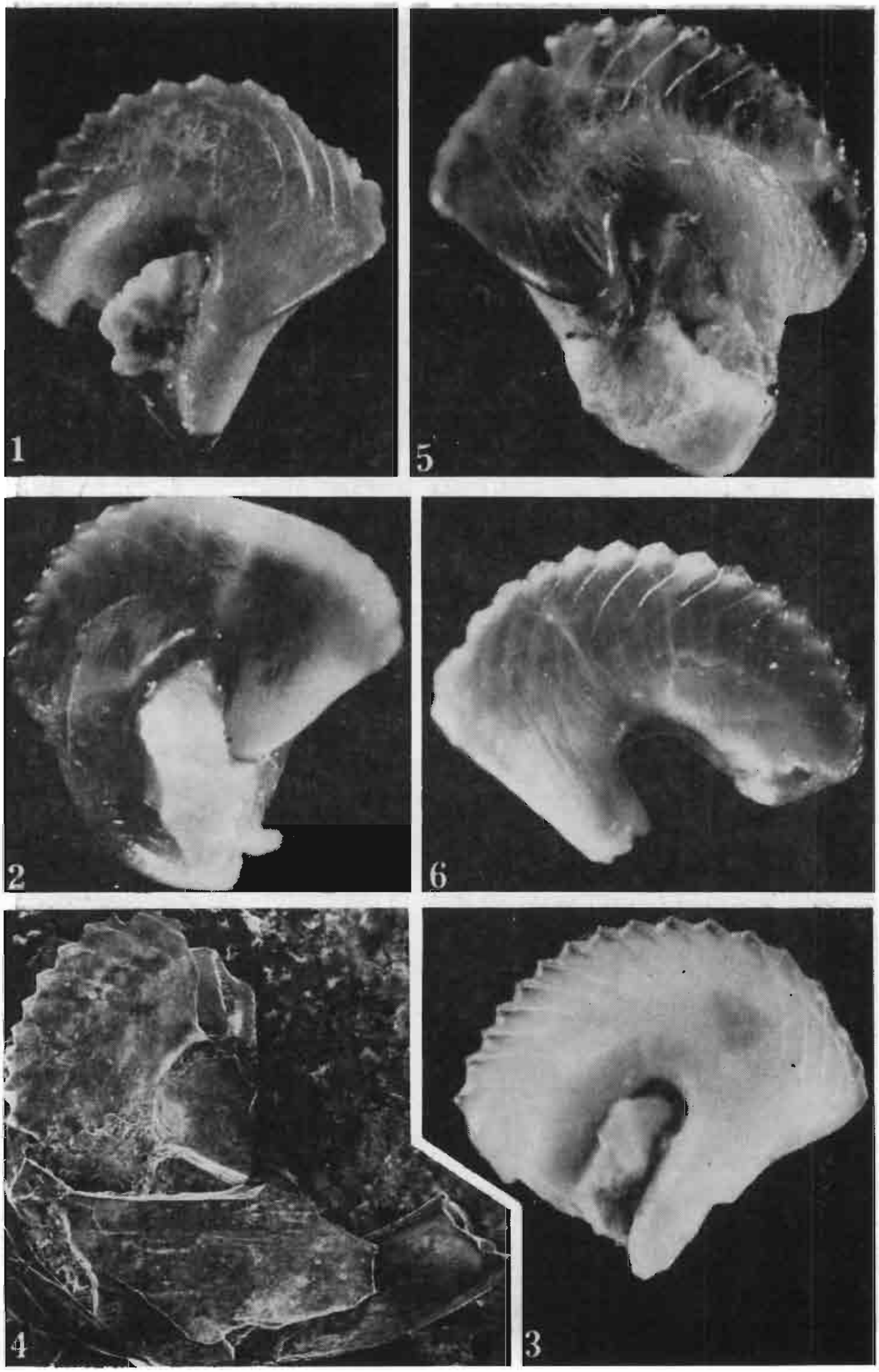
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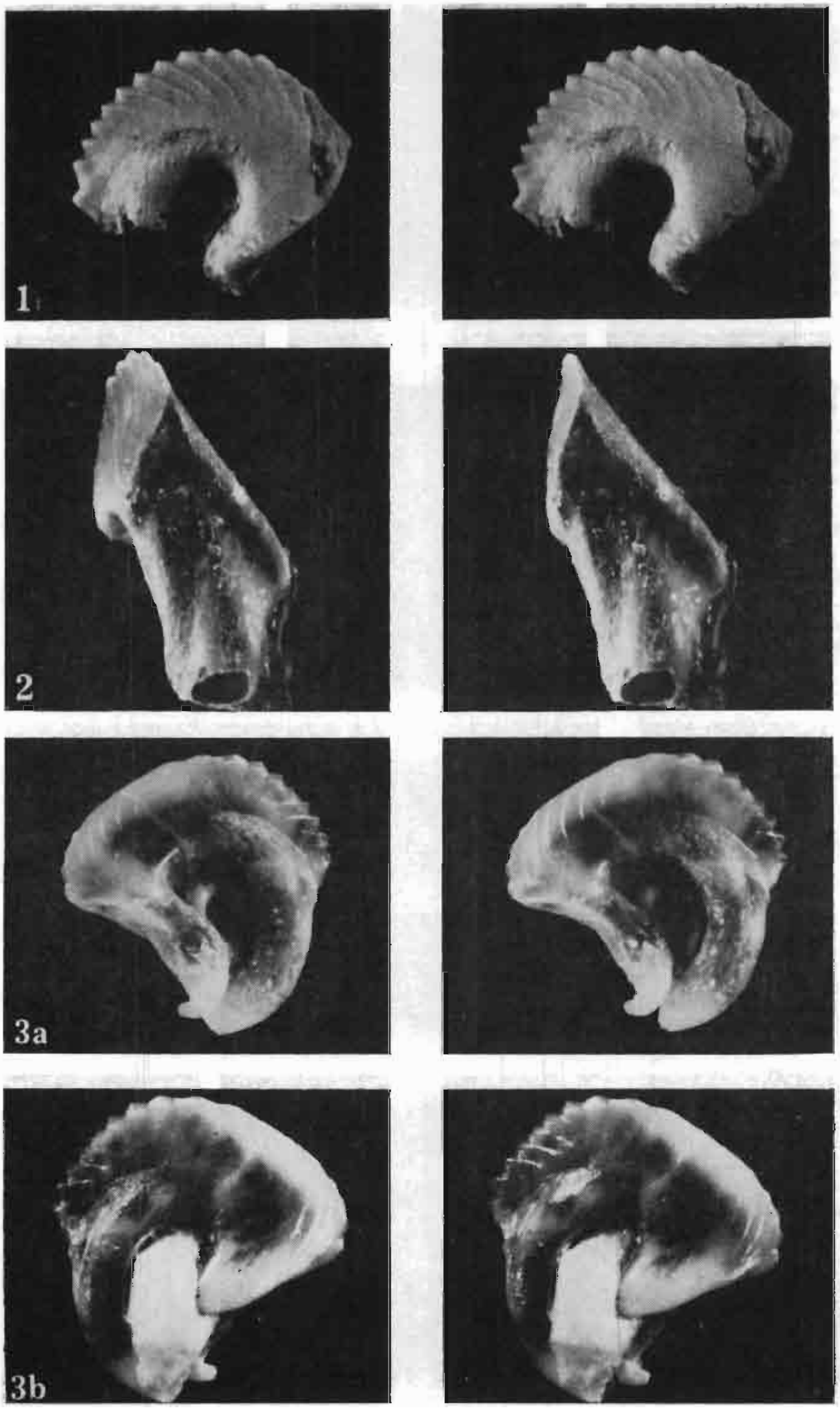
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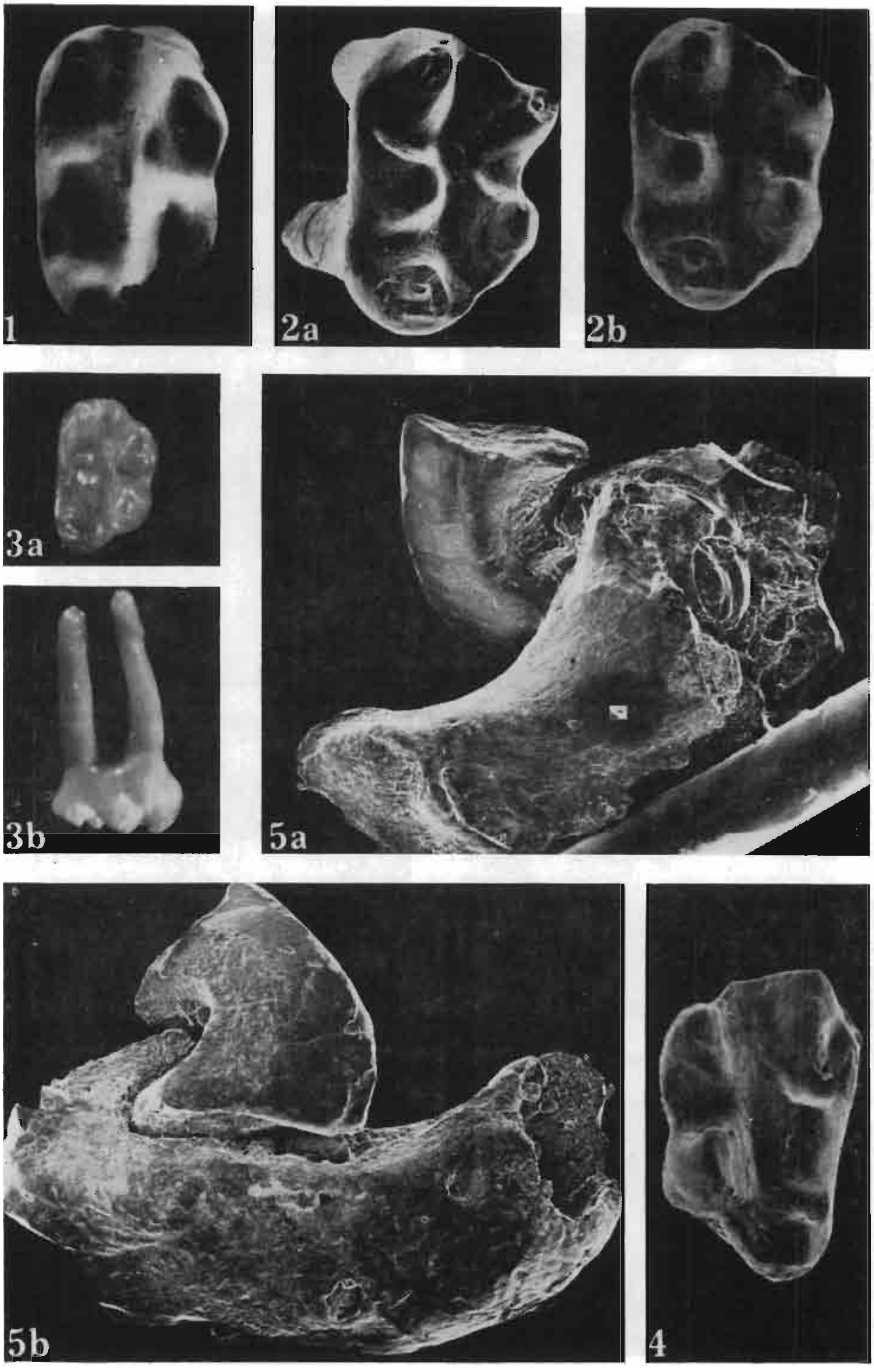
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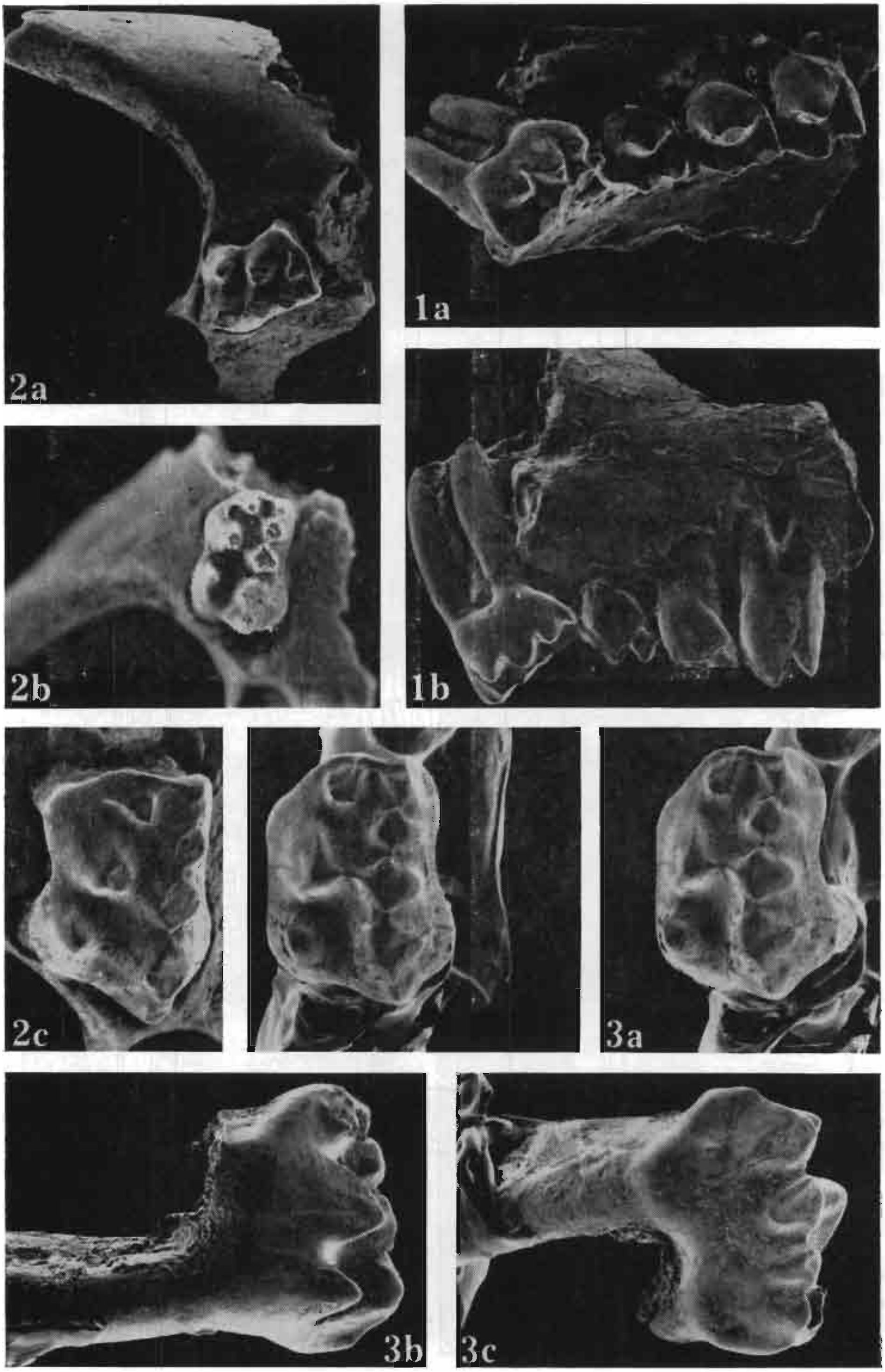
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1b
2c
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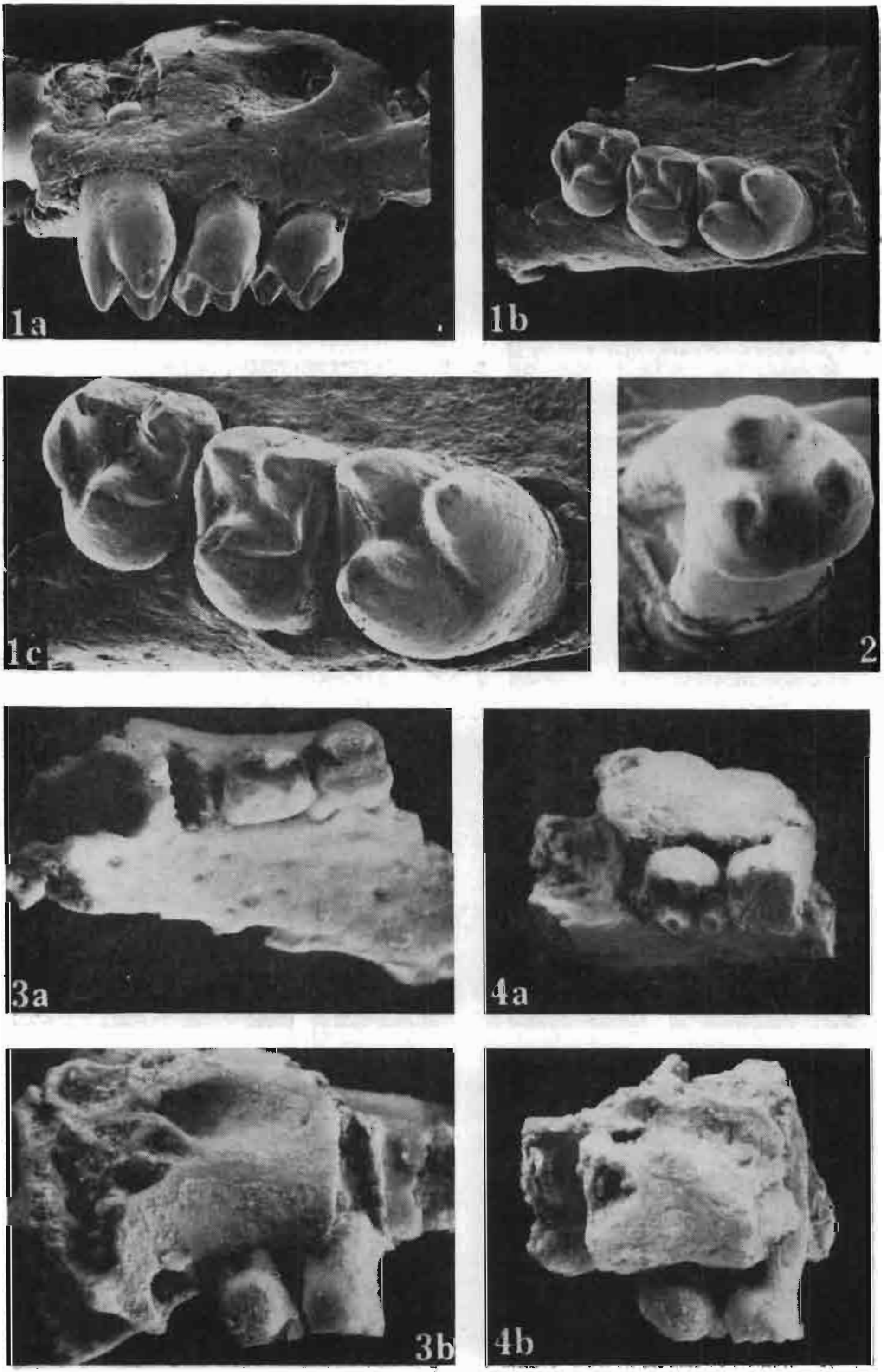
3b
3c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